

# Aviation Week

*and Space Technology*

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August 15, 1960

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Sept. 1-10-1955 *California Medical Society  
Annual Meeting*, San Francisco, Calif.

Aug. 28-Sept. 6-1955 *National Air Rally  
Management*, National, Miami Springs,  
Florida

Sept. 1-Symposium on Ricketts and Soil  
Infection, International Society of Bacteri-  
ology, Washington and British Imperial  
College, London

Sept. 4-10-1955 *Cloud-Crystal Airplane  
Races*, Lakeland Airport, Clearfield,  
Pennsylvania

Sept. 5-10-1955 *Phonograph Trade Dis-  
tributors' Convention*, New York, New  
York

Sept. 14-1955 *Automotive Control Con-  
ference*, Indianapolis, Indiana

Sept. 14-1955 *Medical Association of  
Institutional Society of America*, American  
Society of Mechanical Engineers, Amer-  
ican Society of Heating, Refrigerating and  
Air Conditioning Engineers, American  
Institute of Chemical Engineers

Sept. 4-10-1955 *Logan and Operations  
Conference*, New York, New York

Sept. 8-10-1955 *National Convention  
CSI Club of America*, Tuxedo Hotel,  
Columbia, South Carolina

Sept. 8-10-1955 *Annual Titman-McNeil  
Conference*, New York University  
College of Engineering, Bronx, N. Y.

Sept. 10-1955 *Annual Meeting of the  
U.S.A. Cosmopolis Conference*, New York,  
New York

Sept. 12-16-1955 *Annual International Congress  
International Council of the Americas*  
Hotel Americana, New York, New York

Sept. 12-16-1955 *Annual USAF Safety Con-  
ference*, Maxwell Air Base, Civil Spain  
Office of the Deputy Inspector General  
of the USAF, Dayton, Ohio

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(Continued from page 5)

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Continued on Page 10

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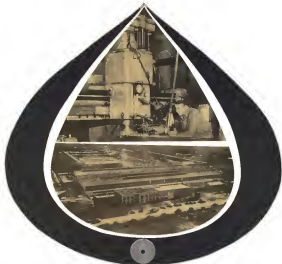
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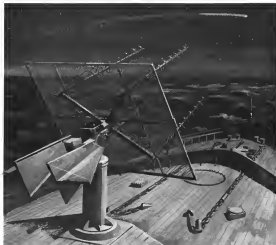


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# NOTHING IS TOO FAR OUT.... FOR GRUMMAN TO BE IN

This is a super screen photograph of hypersonic Mach 8 flow about a delta wing with underwing cone, taken in Arnold Engineering Development Center tunnel B. Photo was made during Grumman research experiments, partially supported by Air Force Wright Air Development Division Flight Control Laboratory.

Shock pattern is discernible along the shock layer on wing (light area), boundary layer on wing (dark region), and shock layer on body (dark region). Bright white line on underside of wing and body is reflection of light screen.

This photo characterizes the work Grumman is doing in hypersonic aerodynamics. Other efforts at Grumman include continuing design and development work on orbiting observatories, interplanetary communication systems, re-entry vehicles and reconnaissance satellites, to name a few.

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## The Air Force Missile Family... Scions of Space Technology

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The Air Force missile family including Atlas, Thor, Titan, and Minuteman, has achieved progress beyond expectation in a program unmatched for magnitude and complexity.

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## EDITORIAL

### Defense Battle Raging

The executive and legislative branches of the government are locked in a bitter battle over U. S. defense policies in the 86th Congress struggle through its final session. The outcome of this battle has an enormous potential for the future of this nation, not only because of its influence on the presidential election in the fall but also because of its effect on our defenses in the long-term struggle against the Soviet Union. There has been some pretty bitter debate within the executive branch of the government as to the need for a major acceleration of the defense program (AW Aug. 1, pp. 21 and 23) and President Eisenhower, returning to Washington from New York, has called for more resources in key military programs.

In light of the President's better recognition of critics of his defense program with his "John's boys" reference at the Republican convention in Chicago, it is interesting to note that he is now recommending most of the things those critics have been pressing for and has, in fact, thoroughly reversed his own record of last January on such key issues as the B-70, strategic air mobility, command and control, and the defense budget. If the John's boys have started the President into radical shifts, of this kind of action to convince him that change is his decision were required, then that effort was indeed well spent by the President for their "patriotic" views, as proved in honest testimony given in response to the national warrents will also take some satisfaction from the President's recent recognition that their recent recalcitrance.

The President's own defense program was greeted with newspaper headlines proclaiming "The Orderly Defense House," which is no doubt what Presidential Press Secretary James Hagerty was aiming for. However, on closer examination of the details involved in the President's message and the related action taken by the Defense Department (see pp. 38-40), it becomes evident that there is no doubt at all, even across the Atlantic, and a general consensus in the defense community, of the program cited by the President will really be accelerated.

### Out of the Fog

What emerges out of the fog of White House press agents and Pentagon jargonology appears to be the following:

• The President has merely authorized spending of a fraction (5475 million out of 53.1 billion) of the funds he had earlier unopposed. Total of 5621 million is still being frozen in the Pentagon according to documents submitted by the Defense Department congressional, while another 5875 million in the original budget is "unopposed" but undergoing further review. "which is another Pentagonian phrase for freeze. The 5621 million still frozen just about equals the \$600 million net boost added by Congress to its Fiscal 1961 defense out preparation.

• The President now recommends a course of action on key programs, such as the B-70, Sars, strategic airlift,

Army modernization, and airborne alert, advocated by the "John's boys" critics of his original Fiscal 1961 defense budget when it was submitted to Congress last January. However, inasmuch as it can be determined at this time, none of the recommendations on the projects is sufficient in scope to achieve the full objectives of each program within a time scale to achieve maximum military effectiveness. To see an old Army phrase, the defense program recommended last week to Congress appears to be "a bit late and a little short."

• The President presents as a military asset his defense program a decrease to achieve a position of Strategic Air Command's B-47 fleet originally scheduled for retirement because of obsolescence. We fail to see the military value in retaining a larger number of obsolescent aircraft still further into this period of decreasing military advantages. The fact of difficulty experienced in Soviet all-weather interceptors is not only in catching and destroying an RB-47 in a 200 mi. strike class does not appear sufficient in relation to this weapon even longer than originally planned. Not a word is mentioned in the President's defense message about expanding or accelerating the superheavy B-57 bomber program to provide a more serious, or military effectiveness over the B-47 fleet. This program remains fixed at the relatively insignificant quantity of three wings of 45 aircraft each. Nor is there a word about accelerating KC-135 jet tanker production where a critical bottleneck in SAC's efficiency has been artificially created by a budget decrease.

### Soviet Truculence

The increased Communist truculence in the past few months has been a predictable reaction to the budget-shrunk U. S. defense policies of the past few years. Rightly or wrongly, it is evident that the Soviet leaders feel a shifting balance of military power enables them to shatter their so-called peace objectives and demands they make known as in the credit freeze. We can have seen the UN Security Council debate on the RB-47 case, but how U. S. arms are dead from Soviet cannon fire and two are still being unaccounted for in Soviet ports in defiance of even precedent of international law.

The state of the world has deteriorated too far and the state of our defense as the only solid bulwark against the spread of Communist expansion is too important to be handled by short-term political efforts. Both parties recognized this in their own criticism of adapting defense platforms that forced a price ceiling on the security of this nation and called for sound, coordinated and integrated approaches to the defense problem.

The recent presidential defense message to Congress is too imprudent to earn such success for the American people whose future is at stake or determined to the Soviet leaders who are gaining our strength and determination as a basis for their own aggressive policies. To borrow a phrase from the President's Chicago speech, it "does such violence to my sense of what is right that I have difficulty in restraining my feelings of indignation."

—Robert Hertz





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## Washington Roundup

### Man-in-Space Group

Space Science Board of the National Academy of Sciences/National Research Council has at last decided to create a man-in-space committee. The board has made important contributions to National Aeronautics and Space Administration's overall planning, but man-in-space members have remained skeptical about the wisdom of sending man into space.

Now, almost two years after its creation, the board has been convinced by proponents of manned space flight that it should have a committee to deal with that aspect of space technology. Presumably, those who the board also first became convinced and later convinced others have concluded that the only real rule man will have in space will be of a military nature. Dr. Chris Lundberg of the University of Pennsylvania will head the man-in-space committee.

Another attempt to make the International Academy of Astronautics a truly international body will be made this week at the eleventh annual Congress of the International Astronautical Federation in Stockholm. Key is participation in Soviet Union, which so far has not given official sanction for its space scientists to participate.

Soviet Prof. Leonid I. Sidor, IAF president, will be presented with a new passport for composition of the academy that has, moreover, some Russian objectives. As is all international groups, they want science that they only will be at least as important as that of the U.S. Although creation of the academy has been generally a U.S. effort, Academy would have three main divisions for the basic, applied and life sciences.

### Restricted View

Federal Aviation Agency from its delegation to the Soviet Union will get a restricted view of air transportation and traffic control developments during its visit next month. Applications from State Department restrictions on the Soviet civil aviation group now touring U.S. facilities.

State Department asked to let the Soviet delegation visit the FAA National Aviation Facilities Experimental Center at Atlantic City. Soviets originally asked to visit Indianapolis, apparently because they thought the center was still B-29. FAA suggested that State, select Atlantic City, but the suggestion was vetoed because the Russians did not wish to visit Atlantic City.

FAA expects the Russians to meet with their traditional uncensored attitude and has the IAS delegation from an significant view of latest Soviet developments in air navigation and traffic control systems.

Dr. Martin Stern became assistant defense director of research and engineering for strategic weapons this week. Stern was still executive for research and development for General Dynamics Corp. He also has been serving on an advisory committee to the board of the Institute for Defense Analysis, the corporation formed by a group of universities to study defense research problems.

Stern, a mathematician, was a consultant to the Air Force Scientific Advisory Board for two years. He was unsuccessful in winning Air Force Office of Scientific Research's atmospheric renaissance, current USAF studies of the Midwestern intercontinental ballistic missile (AW 100 18, p. 20) and Project Starling, a program to export leading young physicists to scientific positions, some related to defense.

### Ferret Jitters

The U-2 incident may have caused more Soviet concern over reconnaissance ferreting than over the widely-publicized photographic aspects of the flight. Some observers now feel there may be a link between Russia's interest in what they call the U.S. "radio-behavioral reconnaissance apparatus," their shooting down of RB-67 ferrets, loaded with ferret gear and capturing of ferrets, and the apparent refusal of two experts of the National Security Agency, NSA, deals with monitoring of other nations' communications and with security of U.S. communications.

State Department is following foreign governments of U.S. plan to put a cloud of thousands of free, inflatable balloons into orbit in a private communications satellite. This move is intended to improve other nations and their countries that the cloud of reflecting satellites may interfere with radio communications or intercepts. State hopes to launch balloons before the cloud goes into orbit during the coming year.

Soviet Union claims it holds a majority of all world aircraft and helicopter records as the result of the large number of marks set and confirmed in Red Airline Aeronautics' international during the last half of 1958. Russians now claim 80 records, and this part out that most were formerly held by the U.S. Three of these records have been won back by the Soviets with its Bell HU-1 helicopter, see page 31.

—Washington Staff



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## Provides Tough Support Test for USAF

**Exercis.** France-Ugand United Nations call for immediate and sustained U.S. Air Force support of its mission to restore calm within the Congo. The public presentation a severe test of USAF's emergency airlift capabilities as well as its flexibility in coping with the unknown.

Approaching on a limited scale a wartime maturity of effort, writers and operational commanders were faced with a myriad of problems, ranging at times from a crippling lack of communication facilities within Afloats to the fact that often only the flight crew had more than a general idea of just where their particular aircraft happened to be.

When the airlift alert was first received here at Headquarters of the 122nd Air Division, which subsequently commended the operation and also threw its force of 45 Lockheed C-130 transport aircraft into the battle, almost all Air Force support facilities, including communications, came to an abrupt end along the northern fringes of the African continent, the limit of USAF's normal operations within the

There were no weather stations, no navigation aids or airport landing patterns for flights into Central Africa. The airports, except for fading World War II memorials, were largely unknown and their names were as unfamiliar as their runway lengths. Where, how and when fuel could be obtained and in what types and quantities were equally unknown.

Availability of crews, both for C-130s and the aging Douglas C-124s of the Military Air Transport Service that were rushed in to join them, was marginal when compared with the effort required

To complete the cycle, Einar's 7,600 ft concrete runway was underfoot again when the initial alert was sounded and, throughout the maximum shift effort, the second of the 122nd had to operate from a runway which, although equally long was without visible intensity lights or other landing aids and has a width of only 75 ft.

Despite these obstacles and the fact that the major force was composed of cholesteryl MATS C-134s, which ranged in numbers between a maximum of 60 and a minimum of 70, the Air Force pushed into the Congo a total of 9,095 troops and 5,591,000 lbs of equipment and supplies during slightly more than two weeks of intense push between July 15 and early August. During the peak of the airlift, slightly more than 100 aircraft were functioning through the Congo system

one particular day. The troops, sought thousands of the United Nations force, that had been formed was in Chicago by late last week, representing

ware solutions, and they were picked up by USAF aircraft from near and far, scattered across the face of Africa plus one field far to the south in Dublin, Ireland. Cargo loaded by USAF aircraft to the Congo included 2,400,000 lb of equipment for UN troops and Air Force support teams, 1,600,770 lb of containers and 582,035 lb of food.

While it proved to be a more busy day and when asked by the UN, the AF Force last week cleared out its entire backlog of requests when 16 C-130s completed the airlift of 804 Mub troops to the dog-headed report of Kim Jong Il's death within the Congo. Following a list of the major USAF troop and cargo airlifts made to the Congo from various sources.

- **Trip to Leopoldville, 2,101 L** means troops and 418,916 lb of equipment (four separate lifts resulting total of 7 C-130s, 17 C-119s)

- **Relief Morocco**, and nearby Somalia. The *Shannon* Air Base of Strategic Air Command in Langleyville, 2,400 Moroccan troops and 353,062 lb of equipment in three separate lifts using a total of 3 C-130s and nine C-4s.
- **Crane to Langleyville**, 611 Sicilian troops who had previously been at Beirut at UN request. Crane Ship 16 from Egypt and Israel, and 145,100 lb of equipment with 12 C-130s.

• **Accra, Ghana, to Leopoldville, 57**  
Chen troops and 120,000 lb. of cargo  
went on two lifts with 30 C-119s, then  
C-130s

- **Conakry, Guinea**, to Loquahell  
790 Guinea troops and 152,000 lb of  
equipment with one C-124, 13 C-130
- **Roberts Air Base, Liberia**, to Lomp  
ville 790 Liberian troops and 38,000 lb  
of equipment with four C-130s
- **Adda Ababa to Stanvilleville**, 14  
Ethiopian troops and 203,645 lb  
equipment with one C-124, 22 C-130
- **Dahla to Goma and Kinshasa** in  
Congo 678 South African and 770,000

- **Chickasaw Air Base, France,** 190,000 lb of equipment with IN C-130s
- **Chickasaw Air Base, France,** 190,000 lb of equipment with IN C-130s
- **Chickasaw Air Base, France,** 190,000 lb of equipment with IN C-130s

- Lamer, Togo, to Leopoldville, 200 000 lb of fuel in seven C-130s.
- Bordeaux, France, to Leopoldville, 451,000 lb of C rations in seven C-124s, 11 C-130s.
- Frankfurt, Germany, to Leopoldville, construction equipment, medical supplies.

100 512 lb. in four C-124s, one C-119.

- **Chattanooga to Leopoldville.** U.S. Army component to support UN forces carrying 70,000 lb. in one C-124.

- **Frankfurt to Leopoldville**, in Belgium, 11-13 September weighing 21,365 lb in total (124).
- **Ramstein Air Base, Germany, to Leopoldville**, 5,400 lb of infants packed UN 146 in total (124).
- **Frankfurt to Leopoldville**, five generators weighing 17,400 lb in total (124).
- **Malmö, Sweden, and Gandermsund**

• Frankfurt to Leopoldsdorfer, 548,374 lb of Customs, vs 33 C-126, less C-439.

On the other hand, however, the current war effort elongated with refugees, particularly during the 1970s, when the European was asked to leave the Congo. It is as a result, incidentally, the refugees were then drafted to Brussels, where they lived in the Belgian World War veterans' evacuation effort (WW Aug. 1, p. 40) with the C-130s, civilian planes, the C-124s, their home base in Guatemala. But, as the demand for soldiers, and within Africa (economic and humanitarian point for the C-130) was shifted from Africa, to which the Air Force, Libya, in an effort to win the country, was not of much aid. The UN designated Sub-Horn point on the continent—Western Africa, China, Korea, Nigeria and India. Second.

At Salt River, ports, refugees were turned over to Red Cross representatives and officials of their respective countries who arranged other transport for the final leg home.

Every fall, if not from mass refugees like the Congo about 1961, as craft an art in exile, and may never be but approximately 2,300 was flown into Europe, almost most of them before the '60s. However, parts were displaced. Refugees were predominantly Belgian but included citizens of the U.S. (Sweden, Italy, Holland, Greece, Portugal, France, Germany, Great Britain, and Canada).

All in all, as the UN reports, if troop movements were channelled into Easton through Wiedbaden, Germany headquarters of U.S. Air Force in Europe, the airlift route rule structure would be about 11,000 man a day (NA, see item 31).

C-130s of the 322nd Airlift Sq. fly an average of 2,300 hr per month on regular scheduled cargo runs throughout Europe, and into the Near and Middle East on medical evacuation flights, training operations with the Army and on special missions, including transport

of diplomatic personnel to points beyond the Iron Curtain.

On July 17 when the winds began to crank to full force, the Division's 45 C-119s had amassed a total of 500 jet hours, or 10 times as much as the 50 C-119s had in the month prior to July 17.

Retroviral MNV3 C-124 squadron of Rhine-Meuse Air Base near Frankfurt, Germany, which is attached to the 12th Air Group, is going to fly about 900 hr per month with its 12 aircraft. Starting with 360 hr on July 15, the squadron ended the month with 1,375 hr.

The C29s of MATS previously sent to Chatterbox-pulled together from Israeli and crews heavily trained to Europe from Dowdair and Charleston AFB. S. C. Dorey AFB (Del.) and McChord and Tropic AFB in Washington. In a total of approximately 7,000 lbs. in less than three weeks, with total number of planes or land fluctuating between 60 and 70 depending upon the rate of replacement from the U. S. and develop new aircraft preparing to return to home base for major maintenance. Another 12 aircraft were supplied by the 52nd Squadron of the 3rd Air Transport Wing on rotation duty at Rhine-Main, when the sixth began.

Of this total, approximately 1,000 lb. was directed into the wolf pipeline. Remaining 1,000 lb. was eaten up on flights from the U.S. to Chetumal.

Three Fairfield C-119 squadrons of the 322nd transfer into the branch to fill European route schedules abandoned by the C-47s, boosted their normal monthly flight hour total by about 200 hr—from 2,400 to 2,600.

Overall job total averaged within the theater of operations—including that of the C-119 squadrons and flight of five 322nd C-119s to Longobardi where they were turned over to the UN for support operations within the theater.

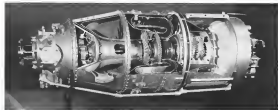
During the run, while piles of materiel were off-loaded, MA1S C-124s flew a total of 151 sorties enroute into Africa with troops, supplies and equipment. C-130s of the 32nd added another 341.

At Clatskanie, Provisional Wing Commander Carl Wilkins Schwab said the base C-224 crew as they arrived from the U.S. and landed there into a total of 54 segmented zones of eight men each—three pilots, two navigators, two flight engineers and a loadmaster. With segmented crew aboard,



2017) was, there was brought to Leopoldville from the U. S., then painted with the U. S. colors. Below a 1946 C-124 was in the museum at Leopoldville Airport.





### Mockup Shows T74 Engine Layout

Cutaway mockup of the Canadair Jett & Wilbur FTS 100 ship turbine engine now showing the ultimate design of T74 shows the double ground fire turbine head. An intake plenum chamber and three stage axial compressor is at right. Gas flow through firing turbine (center) drives low turbine, which is linked through planetary gearing (left) to the propeller shaft (AW Sept. 21, p. 34).

### News Digest

Gen. Nathan F. Topping plans to retire before his second tour as chairman of the Joint Chiefs of Staff expires next August. While House and Gen. Topping has been discussing his retirement with President Eisenhower for some time, but no date has been set.

Thomas G. Langhorne, Jr., has been appointed vice president planning for Florida Wiltner Corp. He will be responsible for advanced planning for the products of several subsidiaries of Wiltner Corp., a company whose business is split 55, military and 95% commercial. Langhorne accepted as vice president and assistant to the president of Wiltner Corp. Division of General Dynamics Corp. in March to challenge Administration defense policies in a private office.

West-AS rocket propulsion motor that has been scheduled for late September to allow time for modifications to be made as a result of the low-A price test last month.

### Atlas High Flight

Cape Canaveral, Fla.—USAF-Corpus Atlas 12 missile was fired 7,000 mi. last week as a flight that tested its Ground-to-Air Missile 1 (GAM-1) was fired in the air of approximately 1,000 mi. to give an idea on its re-entry heating, loading and vibration. Normal upper for the used 6,000 mi. range Atlas flight is 100 to 600 mi.

Allen F. Douvan has been appointed senior vice president-technical of Scripps Corp. He formerly was vice president and director of Advanced Systems Planning Division of Spac Technology Laboratories, Inc. Douvan has been appointed vice president of Scripps Corp. The vice president director of STL's Advanced Systems Planning Division.

Complete Air Force Maintenance Assembly Complex will be constructed next to Boeing's Developmental Center in Seattle for testing the Maintenance weapon system. No studies will be fired from the site. Included will be an underground launch site, launch control center, fueling for the mobile vehicle missile and support buildings.

Douglas will deliver 21 Thor missiles to Air Force for continuing supply and spare program under long-term (10-year) contract. The missiles will be modified to accommodate Apollo B around stage vehicles. Seven of the missiles, previously ordered to be tested, will be modified, and 14 of the 21 will be new vehicles. The missiles will be postpaid by a 165,000 lb. thrust engine, 15,000 lb. gas turbine thrust provided by the current Thor engine. Eleven of the missiles are to be assigned to USAF's Greenhouse program and the remaining 10 will be assigned to NASA for its space program.

Reduction of maintenance costs from the North American X-15 speed run at Edwards AFB on Aug. 4 (AW Aug. 8, p. 10) shows that plane attained record speed of Mach 3.51 (2,166

mph) at 66,000 ft. Preliminary figure of Mach 3.2, 66,000 ft. was based on pilot for Walker's report and radar tracking. Previous speed record of Mach 3.275 (2,094 mph) was established in the late Capt. Milburn Apt in the Bell X-1.

Hawker P. 1127 strike fighter that will have STOL capability will make its first flight next month at Donastad, Sussex, England. Prototype will be the Bristol Saddle B. 15 from special engine (AW Dec. 25, p. 67).

An F-4E Strike Missile Division formed next to Strategic Air Command the first of its kind, operational Atlas ICBM complex at Warner AFB, Cheyenne, Wyo. Complex includes three launchers, a control center, a guidance system and associated ground support equipment. Additional launch positions for the 54th Strategic Missile Squadron are undergoing field installation and checkout.

### Zen Test Facilities

Washington—Facilities for launching latest type Nike Zen missiles from Navy Missile Test Center at Ft. Meade, Md., including two other launchers, a weight and balance tower, three missile assembly buildings and guidance structure are under construction.

Test firing of an American range with standard guidance will start over the Pacific Missile Range early next year. Later long will shift to Keweenaw Atoll where the missiles will be fired against Atlas ICBMs launched from Vandenberg AFB, Calif.

### Confidence counts and the airlines count on Sinclair

45% of the aircraft oil used by major scheduled airlines in the United States is supplied by Sinclair. Military jets also count on Sinclair to supply Sinclair Aircraft Oil to lubricate their mighty engines. There is no better proof of reliability



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## Trunklines Lose \$5.1 Million in First Half

Loss blamed on load factor decline, cost increases; lower yield from growing coach business also cited.

Washington-Denver trunkline, currently in the grip of a decline in the rate of traffic growth, will report a net loss after taxes of an estimated \$5.1 million for the first six months of 1990.

According to preliminary figures filed with the Civil Aeronautics Board, five of the 12 trunklines will report losses totaling approximately \$13.8 million, a figure that rises if the industry record the \$6.7 million net profit the remaining seven carriers will report. Current operating losses to the CAB are Capital, Eastern, Northeast, Northwest and TWA. Capital's loss has been estimated, since, as of late last week, the carrier's filing revealed only the first five months.

The poor industry showing has been largely reported by most observers following the first decline of traffic growth during the first six months of 1990 (AW July 13, p. 38). The 7.6% gain in passenger revenue miles registered during its first half of the year fell far short of the 14% increase that triggered the first period of annual growth in the year's growth rate.

Declines in the load factor level during the period compared with the levels reached during the six months of 1989 plus a continuing rise in expenses are attributed to three reasons behind the

losses. During June, nine four of the 12 trunklines reported an increase in their median load factor.

Expenses for the industry during the first six months showed an estimated \$841 million compared with \$901 million reported for the same period last year. Some factors for the period include the first period of annual growth of 3% according to CAB figures.

Eastern Air Lines and National Airlines' operating revenues for the first six months of this year fall short of the six months revenue figures attained in the same period last year. United Air-

lines' operating revenues climbed only \$16,000, a total of \$167 million during the first six months period, compared with the same period last year. All three carriers showed a substantial increase in expenses, a trend since of the 12 carriers.

Despite the recent increase in passenger fares authorized by the Civil Aeronautics Board (AW June 27, p. 41), a number of observers are pointing to a lower yield as another possible reason back of the losses. For the first time in history, coach traffic is beginning to overtake dispatch traffic and the difference in yield per passenger mile is depressing revenues.

The trend toward coach travel appears to be rising among airlines, particularly in the number of hub-and-spoke itineraries. Shorter travel times with the jets apparently are no longer involving the additional benefits passengers get from packing heavier loads aboard. Service travel and the shift of passenger from first-class to second-class, especially on the jets, more than offset other income reductions in the quality of service provided on coach flights. In addition, a number of large industrial and business firms are encouraging their employees to use coach as business travel rather than first-class since the savings as a large volume of travel can be substantial over a long period of time.

A number of leading airline officials have been saying for several years that the differential between coach and first-class has increased so that each mile will cost less to fly, but the slight difference in service now exists. Generally, it is felt that unless such a move is taken soon, first-class travel demands will suffer the setbacks it is experiencing in international flights. The growing popularity of the low-fare class on North Atlantic services is disruptive to the first-class line, but two-thirds of all international travel was domestic last year. Towards next year, there have been speculation completely to eliminate first-class on North Atlantic services is disruptive to the first-class line, but two-thirds of all international travel was domestic last year.

Among the domestic trunklines, coach load factor rose 62% on 10.6 billion available seat miles during the first half of 1990, and first-class load factor fell 27.1% on \$3.5 billion available seat miles.

Another reason given for the cause of the tight profit squeeze during the first half of this year is the high cost of making the transition from propeller-driven transports to turboengine-powered jets.

United Air Lines was able to experience a first quarter loss as its oper-



First Flight Photo of Soviet An-24 Turboprop Feederliner

First flight photo of the Soviet An-24 turboprop feederliner (AW July 21, p. 46) points up sharp increase in air transportation and high fuel cost. This was designed for flights in 1,200 to 1,500 ft cruise altitudes and will carry 40 passengers in a high density seating configuration. Powerplants develop about 2,000 each, and plane will operate at 20,000 ft altitudes.

ating profit and a gain on the sale of assets during the second quarter. United's President W. A. Patterson noted "The sector of 1989-1990 accounted United a transition period to jet operations and now as we begin to experience the anticipated benefits."

United earned a net profit of \$4.4 million in the second quarter compared with a \$1.7 million net loss in the first quarter. Net profit for the six months was \$1.7 million. Gross revenue, of which about 40% are accounting to \$2.5 million, converted a \$1.1 million operating loss to the net profit.

According to the preliminary CAB figures, TWA also showed a substantial profit in the second quarter to help offset the \$12.2 million net loss shown for the first quarter on CAB records. Net loss for the first quarter can be estimated at approximately \$2.5 million.

Eastern Airlines reported a first quarter loss of \$446,960. Preliminary CAB figures indicate that the airline will show a profit of about \$447,000 in the second quarter, but quite sufficient to give the airline a six-month profit. The slight decline undoubtedly will be wiped out during the first weeks of July as summer traffic moves to its normal peak.

Eastern Air Lines reported a net loss of \$3.9 million for the first six months, compared with a profit of \$2.6 million for the same period last year. The airline, estimated an \$8 million loss in

revenue during the E-125 labor strike in the first period.

The airline cut net sales by 5.8%, which brought about a 4.3 point increase in system load factors despite a 1.6% decrease in revenue passenger miles during the period. Eastern's revenue load of climbed 10.5%, while revenue fell 8.5%.

Continental Air Lines continued to show sharp gains in its revenues. Total revenues of \$23.7 million in the first half were 67% above revenues during the first half of 1989. The airline showed a net profit of \$19,900 with net benefit of capital gains, compared with a net of \$618,000 for the same period last year after capital gains of \$1 million on the sale of surplus assets.

Western Air Lines, according to the unpublished CAB figures, will show losses in the first and second quarters profit and will end the first six months with an estimated \$1.2 million net profit. Delta Air Lines, with a highly successful second quarter, but a relatively modest profit in the first quarter, will report an estimated net profit of about \$2.9 million, according to the Board's preliminary figures.

American Airlines emphasized that its 24% passenger traffic increase during the first half of 1990 was entirely matched as coach fare travel. During the period coach traffic on American climbed 40%, while first-class traffic

showed only a 12% gain in July, coach travel surpassed first-class travel for the first time, and more than half the airline's revenue passenger miles were generated in Boeing 737 jet transports.

American showed a net profit of \$2.6 million for the period, compared with \$1.1 million in the same period last year.

Given on the side of property during the 1988 and 1989 periods indicated the net figure to \$3.5 million and \$8.1 million respectively.

## CHA Traffic Falls After S-58C Crash

Chicago, Ill.-Chicago Helicopter Airways traffic has fallen about 20% below normal since July 27 when 15 persons were killed in the crash of a Sikorski S-58C helicopter operated by the carrier (AW Aug. 6, p. 39).

On the day of the accident CHA carried 1,182 passengers. The day after, it carried 585. Although traffic forecasts for the first part of August indicated an average daily passenger count of about 1,000, CHA's net revenue only 789 passengers during the first six days of the month.

The mid-summer vacation period that disrupted airline traffic throughout the Midwest contributed to CHA's slump which, in all last week, not showing signs of improvement.

## U. S. Philippine Bilateral Deadlocked

Washington-Philippines and the U. S. is at a standstill on reaching an accord on a bilateral air transport pact, but Mexico and the U. S. had settled their differences and were able to sign an agreement last week.

Initial talks with the Philippines were suspended June 2 (AW June 15, p. 35) when the U. S. refused to let the Philippines demand for capacity increases on U. S. scheduled operations. Late last month the Philippines again indicated that willingness to make agreements, but the overall talks were hindered by the lack of such differences on the capacity issue again drove the negotiations into deadlock.

Following the talks, the Philippines placed a ban on the operation of hub-and-spoke flights. This was lifted two days later, but the Philippine government also forced Pan American to reduce its five weekly scheduled flights into Manila to two hub-and-spoke and two passenger flights a week. The Philippines are insisting that the more air traffic is reduced and not as an aviation objective.

Responding to the Mexico City was closed to end last week with Civil Aeronautics Board Member Alan Boyd and Felipe Barrios of Transportes Eduard Robles representing the U. S. This is how the issue of the bilateral agreement with Mexico are expected to be settled.

Agreements of Mexico will also open to operate a Mexico City-New York route with beyond flights in France. The route probably will not involve the same revenue splitting provisions at the present time because of the heavy expenses involved in conducting such a service.

It will be granted a Mexico Mexico City route to parallel the present exclusive route now operated by Gulf American Mexico.

Boeing will get its long-range jet, the Airbus A300-600, to Mexico. American will get a route Mexico-Toronto-New York and Chicago-Mexico City. American will get a route Mexico-Toronto-New York and Chicago-Mexico City.

Agreements of Mexico will be granted a route from Houston to Tucson Phoenix

# Competition Cuts U.S. Share of Traffic

By L. L. Doty

Washington—Overriding share of U. S. flag carrier on international passenger business is now being attributed to the steady increase in the number of flag carriers throughout the world rather than to the competitive impact of long-established foreign flag carriers. While U. S. flag carriers have suffered declines in their share in virtually all world markets in the face of a 97% average annual increase in all international traffic during the past five years, other major carriers are expected to see counterbalancing increases in the face of competitive markets. And there are no signs that the growth in the number of international carriers is about to stop.

## Nationalistic Surge

The surge of nationalistic new entry by foreign airlines throughout the world is not a new phenomenon to be compared to the establishment of flag carriers in strategic sectors. However, the growth in carriers has cut into the share of U. S. airlines in global markets is illustrated by these statistics: In 1951, U. S. airlines were handling 54% of all international revenue; passenger miles generated by the airlines of 11 countries. By 1958, 71 nations were participating in scheduled airline operations, and the U. S. share of international air transport had declined to 32%. Despite the decline, this accounts for 40% of total carrier, U. S. airlines generally have been able to recoup their volume of business because of substantial growth in international traffic. Biggest loss in U. S. airlines has been in the North Atlantic market.

where the U. S. share of passenger traffic has dropped from 57.4% in 1951 to 46% in 1958. However, the decline has been made up in similar percentage drop in the number of scheduled flights in the same period—from 59% to 37%—and in the number of available seats—from 61% to 36%.

## Hottest Impact

It is in the transatlantic and Latin American markets that the impact of new entrant competing against U. S. carriers has hit the hardest. It is difficult to gauge the number of Latin American airlines offering scheduled service because a number of them are not members of the International Air Transport Association, but the figures have been made public at least in two cases.

From 1955 to 1958, the 38 foreign flag carriers operating out of the Mexico (MEX) to the Caribbean and Latin America increased their market participation from 15% to 44%. There are eight U. S. airlines authorized to operate in this area through the Mexico gateway. Pan American World Airways has attributed a drop of \$13 million to 1958 revenue from the previous year to the increased competition.

Number of carriers operating in the North Atlantic market has increased from eight in 1950 to 15 at the present time. Lufthansa German Airlines, which began scheduled service in 1955, has doubled the biggest gain in recent years of one of the North Atlantic competitors.

During this period of carrier growth, the number of U. S. foreign flag carriers serving the North Atlantic has remained constant at four—TWA and Pan American.

Deep in U. S. share of the North Atlantic market has been due to a sharp decline in TWA's share of traffic. Pan American's growth is at about the same level it reached in 1953, although it surged upward in 1955 and 1956 in spite of the U. S. share from 15% of the total market.

TWA, which has undergone a series of top management changes in the past two years, has reported sharp declines in its share of traffic, although this for five years, it is again making deep inroads against its competitors, due, undoubtedly, to its Boeing 707-320 turbojet equipment.

British Overseas Airways Corp. made notable gains in 1957 following the introduction of de Havilland Comet 4s in October, 1955. This airline now appears to be losing its growth momentum in the market as competition between KLM and SAS cooled last year with a smaller share than they had in 1955, and this trend for these carriers appears to be continuing into 1959.

Swire showed a marked increase in 1959 over 1957, but the airline lost ground during the first six months of 1960. Sabena was down in 1959 over 1957 and is also retreating in 1959, particularly in the latter time. The carrier has apparently slowly increased its position during the past seven years, although it is making a more vigorous showing this year.

Japan Airlines have shown improvement since 1955, but the share of each is still relatively small.

Significantly, the share of traffic taken by the seven carriers which have in total the smallest share in 1959 is almost double the share held by Pan American and TWA. The seven new entrants are Lufthansa, Iberia, Aeroline, Alitalia, KLM, Qantas and Air India.

## Substantial Increases

Scheduled airlines continued to show substantial increases in the number of passengers carried on North Atlantic routes last year to reach a total of 1.5 million, a 17% gain. Total of 800,000 of these passengers were carried on scheduled flights, with the balance coming on special and charter flights. The growing thrust of this type of business to scheduled operations is indicated by specific figures in the categories during the past two years: a 55% gain in 1955 and 75% in 1959.

In the Pacific area, the U. S. has a strong foothold in the market with such Japan Air Lines, which now serves San Francisco, West Coast cities, providing any serious competition to the two U. S. flag carriers—Northwest Airlines and Pan American. Canadian Pacific Airlines op-



South African Airways Receives First Boeing 707

South African Airways' first Boeing 707 is seen at Jan Smuts Airport, Johannesburg, after a 21½ hr. 21,450 mi. flight from Kaituma, West-Midland. South African Airways has ordered four 707s to replace its old aircraft on the African continent. Main carrier of Jan Smuts Airport is being lengthened to 50,000 ft. in an eventual 14,000 ft. to accommodate maximum weight loads for all aircraft port. Second of the three Boeing orders is expected this month, the third is still 1961.

erates through the Vancouver gateway and is not directly competitive with U. S. airlines although there is some traffic overlap as a result of the Canadian carrier's main route.

In the South Pacific, Qantas has been an effective competitor and the new route of Transoceanic Airlines between Australia, (TAA) linking southeast Asia with the U. S. through the Los Angeles gateway, has competitors with Pan American's new routes connecting them to U. S. airlines (AW No. 9, p. 38). British Overseas Airways has been operating a transoceanic route through India since May of last year (AW June 1, 1959, p. 41) but its participation is limited to the capacity provisions of the Bermuda Agreement (AW Aug. 1, p. 47). Nevertheless, it is anticipated in the volume of traffic it now carries out of Hong Kong.

## Pacific Airline Growth

As in the North Atlantic, the mid-share in U. S. airlines in the Pacific has in the growth of new airlines in the Asia-Middle, Philippine Airlines and Kaituma National Airlines has a marked interest in launching trans-Pacific scheduled service. And both airlines can be expected to demand traffic capacity restrictions on U. S. carriers before they agree to a reciprocal closing of routes.

Carl Air Transport, Nationalist Chinese flag carrier, is currently focused in the Far East area by its own charter. However, the Nationalist Chinese government is known to be pub-

lic pressure on the carrier to exercise its rights under the bilateral agreement with the U. S. and to inaugurate trans-Pacific service.

As India India travel, which is already taking a traffic bite in the North Atlantic, after less than a year's stability in the market, plan to expand its routes from India east to the U. S. Venezuela and Chile are also showing interest in extending routes of their flag carriers through the Pacific to the Orient. The latter carrier has even made it possible in their operations in 1958 Pacific destinations.

On a worldwide scale, U. S. airlines received a two year boost by showing a larger increase in traffic during 1959 than that of all other airlines combined. The U. S. rate of increase last year was 17%, compared with 8% for the carrier of other nations. During the two previous years, U. S. airlines reported 15% and 18% gains in 1957 and 1958, compared with 10% and 12% for all other airlines.

U. S. airlines accounted for 66% of all traffic—domestic and international—on a world basis in the past decade, the percentage figure has ranged from a low of 56.7% in a high of 63.5% in 1958 and 63.9% in 1958.

During the year, however, rates of actual other countries also registered traffic increases of 15% or more. These include New Zealand 14%, United Kingdom 17%, Canada 15%, Germany 23%, France 17%, and Italy, 30%. Soviet Union shows another

threw a 46% traffic increase during 1959 (AW Aug. 8, p. 47). Nations which showed flag carrier traffic declines in 1959 compared with the previous year are Spain, Belgium, Colombia and Switzerland.

U. S. airlines' share of domestic revenue passenger miles flown by the scheduled airlines of the world—excluding carriers of the Soviet Union and People's Republic of China—has declined from a high of 77% in 1953 to 71% in 1958.

## Traffic Growth

During the years between 1951 and 1958, international revenue passenger miles increased from 3.7 billion to 8.1 billion, a 115% gain. However, the gain registered by foreign flag carriers during the same period was outstripped by that of U. S. carriers—from 4.6 billion revenue passenger miles to 12.7 billion for an equivalent 175% gain.

Passenger load factors during 1959 rose to 63.5% from 58.5% in 1958 for all airlines operating international services. On U. S. Long-range routes, Pan American and TWA showed load factors of 78.5% and 64.5% respectively, a combined U. S. load factor of 75.7% compared with 63.5% for foreign flag carriers.

Pan American and TWA have no varied positions on load factor since 1953. In that year, Pan American was operating with a 62.9% load factor, compared with TWA's 51.7%. During the year just passed, foreign flag carriers reached a high of 63.5%, a low of

## Transatlantic Passenger Traffic Distribution International Air Transport Assn. Carriers

	1951	1954	1955	1956	1957	1958	1959	1959
Pan American	27.3%	20.2%	21.1%	21.0%	20.2%	20.4%	20.7%	20.4%
TWA	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4
BOAC	11.4	10.5	10.5	10.5	10.5	10.5	10.5	10.5
KLM	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4
SAS	9.8	9.1	9.1	9.1	9.1	9.1	9.1	9.1
Air France	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4
Swire	3.4	4.1	4.1	4.1	4.1	4.1	4.1	4.1
Iceland	1.3	1.7	1.7	1.7	1.7	1.7	1.7	1.7
Lufthansa	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
Alitalia	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
El Al Israel	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Qantas	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Japan	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Air India	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Others	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

\* Jan. 1, 1959

# CARAVELLE

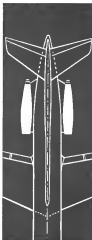
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## Misrair Starts London-Cairo Comet Service

Misrair, airline of the United Arab Republic, has started Comet 4C service between London and Cairo. The carrier will operate a fleet of three Comet 4C aircraft powered by Rolls-Royce turbojet engines.

75-75. One of the major issues now at stake in U. S. foreign policy in the air transportation field is the delicate balance of trade between the U. S. and foreign nations. On the basis of current data, U. S. foreign carriers have earned more abroad than foreign carriers have earned here. But the margin is narrowing, and taking export expenditures into account, the U. S. now has an unfavorable balance of trade with other nations served by U. S. carriers.

In 1952, the net favorable balance of trade for the U. S. was some \$87 million. By 1955, this amount had been chopped to about \$5 million. However, it is estimated that about \$55 million more was spent abroad by U. S. carriers in 1955 than foreign carriers paid out in import costs here to give the U. S. an approximate \$49 million trade credit balance of trade.

On the point foreign flag carriers are quick to agree that such a colossal loss of balance of trade does not show a complete picture of the fiscal relationship between the U. S. and other countries. They say that the estimated \$2 billion which foreign flag carriers will pay for new aircraft plus spares and parts automatically restores the balance of trade on the favorable side for the U. S.

## Fleet Expansion

It is possible that the high cost of operating turbine equipment may discourage acquisition of fleet size or to compete against major flag carriers. However, experience thus far suggests that most airlines will willingly acknowledge operating deficits in order to be accepted in blue ribbon markets with modern and competitive equipment.

At the present time, a total of 481 turboprop transports have been bought by the world's scheduled airlines. Most major airlines have completed the first round of their equipment programs, a number of which have been partially financed by the Export Import Bank of Washington. Carriers with assistance have either the turbine or engine with assistance or both.

Carriers of a few small nations have already placed orders for turboprop equipment—Ethiopian Airlines, for example,

and others can be expected to follow the lead in the early months of keeping their countries flag flying on international routes.

At the present time, the U. S. has bilateral air transport agreements with 53 nations, but only 27 have airlines actually operating into the U. S. On the other hand, the U. S. operates airline service to all but two of these 53 nations: Czechoslovakia and Yugoslavia. U. S. also serves several nations with which it has no bilateral agreement: Liberia and Vietnam, for example.

With the new equipment and the bilateral rights to serve U. S. markets, some of these smaller nations can be expected to request foreign air carrier permits which would enable competition against the U. S. Meanwhile, a reverse trend toward consideration is taking place among larger foreign carriers which, meanwhile, could strengthen competition against the U. S. even more than the addition of new airlines. All signs of major concern, the most significant of such developments being the organization of Air Union (AW May 1, p. 55).



## First Photo of Max Holste Super Broussard

First photo of Max Holste Super Broussard was taken during first flight on July 29. Roger Froment is equipped with Turbomeca Baston turboprop engine, developing 1,000 hp on lift-off (AW Jan 78, p. 57). Super Broussard will be produced by Max Holste and Nord Aviation.



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## Trans-Canada Vanguard Starts Certification Tests

First of 25 Videtur Vanguard 912 helicopter transports ordered by Trans-Canada Air Lines has started flight tests leading to a certificate of airworthiness at Weybridge, England. Tests will be for both Basic Type III, rated at 1545 chp, and the more powerful Type IV, rated at 1745 chp. The latter is expected to be the mainstay of the fleet.

## Allegheny Sees Expansion Of Nonstop Short Haul Services

New York—Piercing margins provide an opportunity for the C.A. Associates Board to overhaul what has become increasingly out of balance air transport route patterns. Lyle D. Barnes, Allegheny Airlines president, told the New York Society of Security Analysts.

Short haul services have steadily and consistently deteriorated in trunk carriers but new equipment into service making stops of 900 mi.—or longer—to make sense, Barnes said.

In its efforts to strengthen the regional trunk carrier, Barnes said, CAA shifted in the airline's fleet mix, adding new, smaller jets with more reliable, without regard to whether they fit the route. "Too many jets left out and not being utilized."

Barnes broke the short haul market dilemma into two parts.

- Terminal effect—Cleveland and Detroit for example—has no longer being used as markets in themselves but is stops on long haul trunk routes.
- Smaller cities that cannot meet and provide service can be served without intermediaries.

Not wide all local carriers agree with him. Barnes noted, but he sees possible solutions in:

- Providing local carriers to compete in short haul terminal markets against trunk carriers without restrictions.
- Finding competitors in marginal, common points between trunk and local service airlines.

## Future Equipment For Local Carriers

Short haul carriers might have to make substantial equipment upgrades in their fleet to the level of technology of trunk carriers, but Allegheny Airlines research is studying some models the potential of VTOL aircraft.

Allegheny is looking at the Fairchild Rotabloc as a type of VTOL aircraft that would fit its route pattern and economic requirements. It has one stage development in its high speed level, Allegheny President Lyle D. Barnes said.

Current rotary wing aircraft are handicapped by high cost of operation, he said, but a four-engine aircraft in the next few years could offer the same low fares. Barnes said the program made in the last two years in reducing the stage length requirement for point-to-point service indicates short haul potential also.

local service airlines. It makes no sense, he believes, for Allegheny to operate alongside a trunk carrier between a city of 45,000 population and a terminal point. Sometimes, such as, the carrier is not "serving the trunk," or "serving the local."

Facing the persistent need for vehicles in many smaller cities and, without replying the federal transportation law, seeing it as a issue so that people in such cities would get for being provided service.

Allegheny's future lies in the concept that it will always be a short haul carrier—that an airline can't be both a short and long haul carrier—and that new ideas like Allegheny's commuter shuttle service will be the means of shaping the future.

The regional Allegheny commuter service between Pittsburgh and Philadelphia is making money, Barnes said, and Allegheny is projecting 25% of the capacity of four airlines serving the market and a return 75% at the bottom.

Commuter service is just about good solid 10% of total commercial aircraft or approximately 5100-6000, Barnes said. Last letters have been increasing over 60%, the revenue in which the passenger line of 511 for the Pittsburgh sector was derived.

Allegheny has found no real loss in the market. In the morning, several jet pilots participate in

# EXPERIENCE



## DH 121

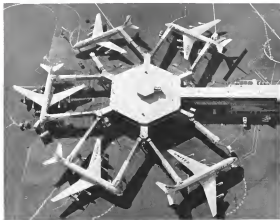
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Powered by the best engines

# DE HAVILLAND



### United DC-8s at San Francisco Terminal

Five United Air Lines Douglas DC-8 jet transporters are shown parked United passenger terminal enroute at San Francisco International Airport. The airplanes are connected to the terminal by telescopic jet-bridges which automatically extend and retract. United has similar facilities in operation at Idlewild Airport. Besides weather protection, the units also eliminate passenger traffic to the ramp.

water traffic rose in the afternoon and evening, but do not necessitate an airplane base. This follows a logical pattern, Barnes said, for a traffic in line with an appointment in the morning means a definite flight and arrival time, covering both is a more flexible situation in which he would rather not be committed to a specific departure time.

Level factors vary considerably, as is typical of commuter run-way flights, are 90% some 75%. Overall, the breakdown as far has been approximately 60% full fare and the balance commuter on the Pittsburgh service.

Allegiance has begun a Boston Philadelphia and Providence Philadelphia commuter service. Initial response has been encouraging, with the Providence service showing more strength.

Barnes is eager to expand short haul service. Allegiance is seeking to take over Pittsburgh-Buffalo, Pittsburgh-Washington, Buffalo-Washington, Buffalo-Philadelphia and Buffalo-

Baltimore routes from Capital in event of the Capital-United merger, but non-stop authority is an essential part of the package. Allegiance also is seeking a Detroit-Cleveland shuttle service in the Great Lakes Service. Investigations which would be operated with Allegiance's regular Martin 307 aircraft.

Revenue for Allegiance are 35% ahead of last year now and he forecast should be making 10% ahead. Barnes said, the lowest revenues of \$17.9 million in the period July 1, 1960, to June 30, 1961.

### Los Angeles Studies Terminal Transport

Los Angeles-Three proposals for on-airport transportation systems to convey passengers within the new 26.5-acre airline terminal at International Airport here are being studied by the Board of Airport Commissioners.

Lockheed Aircraft Corp. has pro-

posed a "horizontal elevator" system of cars suspended from overhead and automatically controlled by the rider so that the passenger can select his station and go directly to it, bypassing others. Each car can carry four passengers and baggage.

Stephen Adams, Vilsy Co. and Goodrich Tire & Rubber Co. have proposed the Air-Plat Converter which consists of two riding on a concrete guideway with a unique arrangement of accelerating and decelerating rollers leading the cars from a turn-around track into the stations. Each of these cars can carry up to eight persons with baggage.

American Crane and Hoist Co. has proposed the American Rapid Transit System, a two-directional suspended monorail system with cars suspended from a stable overhead monorail structure. Cars will be loaded to ground level to pick up passengers and rise to and from level. Each car will contain an operator and 24 passengers.





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## SHORTLINES

► **American South Americans** has received a two-year extension of its temporary suspension of service to Havana due to a "temporarily and substantially decreased" air cargo market at the Cuban capital. America said it could not economically weather the Havana market "until a radical change for the better has taken place."

► **Alaska Airlines** has renewed a \$600,000 contract from Federal Electric Co. to provide an average of six weekly, 12-ship flights from the contractor's depot at Fairbanks to Detroit Early Warning Line stations in the Arctic.

► **American Airlines** will begin Boeing 730 turboprop service from Chicago and New York to Tucson and Phoenix, Ariz. on Sept. 15. Daily service will provide both first class and Kowd Chatham seats. American says it now has served more than 1.5 million passengers with its turboprop fleet.

► **Capital Airlines** reports its schedule performance and on-time record for September was 85.2% during July. That percentage of Capital's flights left within 15 min. of scheduled departure.

► **Civil Aeronautics Board** has issued a Handbook of Airline Statistics covering traffic and financial statistics for the period 1969-1976. The handbook, which has 256 pages, may be purchased from the Superintendent of Documents, Government Printing Office, Washington 25, D. C.

► **Delta Air Lines** has signed an agreement with Arabian Express Agency which will enable companies to ship cargo via Arabian Express to the aircraft airport served by Delta. Delta has a flight from its base in the United States to the airport, which is served by Delta.

► **Eastern Air Lines** has extended its daily line plan to include Monday and Saturday, as well as the mid-week period from Tuesday to Thursday noon.

► **New York Airways** using five 15-passenger Votair 44B helicopters, carried 68,968 passengers in the first six months of this year, an increase of 17,170 over the same period a year ago.

► **United Air Lines** has received CAB permission to temporarily suspend service to Cheyenne, Wyo., until the Board makes a decision on United's request to drop Cheyenne from its system. The city also is served by Frontier Airlines and Western Airlines.

## AIRLINE OBSERVER

► **Airline merger talks continue**, but discussions are on a very informal level with interested companies now only cautiously accepting prospects or proposals. Wall Street is speculating that American-National is the next logical alliance. Focusing is now on timing. Some observers believe a third proposed merger in the hopes would be of major assistance to the Civil Aeronautics Board in plotting an adjusted overall domestic route structure. Others feel that no firm agreements will be reached until outcome of proposed Capital-United and Northeast-TWA mergers is known.

► **Chances are now strong** that British will propose a joint U. S.-U. K. program to develop a segmental jet transport (AW Aug. 6, p. 40).

► **Eastern Air Lines' decision** to lease 10 Boeing 730s reflects in part the reluctance of international leaders to commit give more funds at this time to airline equipment financing. With cash financing unavailable because stock prices are below book value in most cases, airlines are more likely now to turn to leasing to acquire aircraft even though their fleet size may not favor leasing as a primary means of acquiring a fleet of airplanes.

► **Feasibility of a network of ship-based surveillance (VOR) and Texas data processing equipment (DIME)** stations installed on Coast Guard weather ships, which the Navy already will be evaluating for Federal Aviation Agency starting in October and using a trial installation operating off the East Coast. Using existing weather ships, FAA believes it can provide VOR navigation coverage over more than half of the North Atlantic air routes. Gaps in coverage could be partially filled by installing VOR DIME stations on air defense patrol ships and Ticonderogas. The VOR system will be geo-stationed in advance, but will be able to track and follow.

► **Civil Aeronautics Board will investigate "overlooking" practices** of the 12 domestic trunklines. Both "intentional" and "unintentional" overlooking will be studied for the purpose of setting a regulatory policy on restrictions. Unintentional overlooking is caused by substitution of smaller equipment on scheduled flights, lag in communication, human error and the "low side" of seats in one airline on another without proper clearance. Intentional overlooking is overlooking in substitution of no-shows.

► **International Airway of Mechanics** will watch the Civil Aeronautics Board closely to make sure labor protection provisions are included in approval of any of the pending airline mergers.

► **Italy has formally agreed** to exchange traffic statistics with the U. S., but other major European countries are expected to reaffirm current U. S. drive for free exchange of such information (AW Aug. 1, p. 47). At the same time, Italy and the U. S. signed amendments to the bilateral agreement between the two countries giving the Italians the right to extend its transatlantic route from New York to Chicago in a commercial and to extend the route to points in other countries, which will be determined in the future. U. S. agreed the right to serve Rome in addition to Rome, Naples and Milan, which were previously authorized.

► **Federal Aviation Agency plans** to put portions of a newly developed automatic traffic control data processing system into operation in several years ahead of original schedule, without waiting for availability of the complete system being developed by General Precision Corp. FAA will shortly propose traffic control computer, developed by General Precision's Laboratory Division, and automatic flight program data processing, with delivery in about 12 months and expected use in roughly two years. This equipment will provide a traffic controller with automatic preparation and release of flight strips, automatic conflict search and transfer of data.

► **Nation-wide drive** to generate more aerial, parcel post and perishable business shipping has been initiated, but business appears to have paid off for American Southwest airline. During the first six months of 1969, the carrier's annual tonnage increased 40% and cargo volume 20%, compared with the same 1969 period.



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## Lockheed Will Take Electra Loss Now

New York—Lockheed Aircraft Corp. chose a lesson in the heart of the financial community last week to reveal that it had decided to take the whole sum, turn half now on the Electra transport project—and some other, as well—while still seeing a net half net loss of \$15,000,000.

The entire package calls for work, after write-down and adjustment totaling \$65,500,000, after taxes, all to be charged against earnings for the first half.

Chairman Robert E. Gross told the New York Society of Security Analysts that this drawing of the bond will mean a profitable second half. Second half earnings of \$9.10 million, he said, will net the net loss for the year to about \$45 million.

Breakdown of the write-off package, as an after tax loss for the industry, but:

- Modification costs expected for the Electra—\$11,400,000
- Electra development costs—\$1,242,000
- Production losses on 21 Electra delivered in the first half and on 27 Electra, on order—\$18,774,000
- JetStar development costs and maintenance write-downs on 26 airplanes on order—\$31,153,000
- Supermarine transport development cost—\$1,214,000
- Super Hercules development costs—\$715,000

- Write-down to resale value of 21 used airplanes on lease or guaranteed to be resold—\$3,007,000
  - Provision for cost overruns on government contracts, transportation contracts, and support contracts for prior years—\$4,807,000
  - Provision for cost overruns on government contracts, transportation contracts, and support contracts for prior years—\$4,807,000
- Lockheed has reached agreement with operators of 113 out of a total of 115 Electra to pick up virtually all the modification costs, Gross said. In return, Gross said, the airlines must give him the conventional design, among other of the two Electra on-light accidents as the speed returned operators that resulted.

The write-down will offset some of the write-down, Gross said, estimating that \$10 million or more is left to be charged in this fashion. Lockheed's overseas income statement showed at the meeting showed \$57,410,000 in its credits for the first half, based on a profit loss of \$11,775,000.

One question asked by the analysts was whether Lockheed had any more cost, that Internal Revenue would accept its accounting for its purposes.

"This, of course, is a great hazard," Gross replied. "We relied on the advice of our tax counsel, who has been with us for 30 years, and on our ex-

ternal auditors. We have in opinion from outside—strongly enough in our branch—that this lost it will be accepted."

Gross pointed out that there would be different ways in losing between losses in recorded on Lockheed's books and those recorded for tax purposes. Some of the Electra modification costs, for example, will not actually be incurred until next year, when they would be recorded for tax purposes even though those losses are being charged off on Lockheed's books this year.

Regarding last financial year as a new calculation to give accurate after-tax from financial interest, not beneficial of a precedent, but at the same time functions about such problems gross said is applied by investment men.

The use of the total write-off seemed to shock a few in the audience, but the ship did not surprise analysts, who had been following Lockheed's affairs. There was little gross movement in Lockheed's stock, but volume increased some. The Electra modification costs already had been estimated at \$25 million prior to today (NAV Aug. 1, p. 37).

Development costs for the JetStar, Supermarine transport and Super Hercules had been shown in Lockheed's 1959 annual report as a deferred asset on the balance sheet (NAV Aug. 4, p. 39) on the assumption that in military projects, contracts would be forthcoming, signed which these costs could be charged.

Gross explained that the decision for the JetStar determined because of the Administration's interest demand for reduction of expenditures on military aircraft to fund money for missile and satellite projects. Air Force's capital estimates of a military market for 100 airplanes has been brought so far into actual USAF orders for only five. Lockheed is going ahead with production, financing with an excellent credit and military contracts. The JetStar, but not future airplanes will be sold on a lease, profit loss with the write-down out of the net.

Supermarine transport does not exist today, is a project and if there is to be one it must be given sufficient military government or military-industry support. Since this appears to be no such on military project, Lockheed work off the cost.

Super Hercules prospects, which seemed strong to Lockheed a year ago declined with the constant erosion of the military transport development market. Thus Lockheed must do this project through if it continues to progress, a turbulent source, certain as a current military competition.

Lockheed no longer will do commercial

business on the basis of assumptions. Gross said. In the past, calculations were based on probability of loss many airplanes could be sold, but this policy is now firmly abandoned. In the future, product development costs will be written off as incurred.

Both the Electra and JetStar are built on a lot basis, creating the problem of getting enough orders in the time allowed to release the next lot for production. Chicken in the right quarter, for building the airplane at a profit indefinitely will gain in any future sales following a general industry trend away from a commercial sales-oriented approach.

Gross felt that with the write-offs behind, Lockheed could look forward to a profitable 1961. He noted:

- Missiles and Space Division, with its 1960 orders, the company has indicated an absolute requirement of 1,000 missiles, and its Space resources were sufficient to produce a large fully loaded, will do more than \$600 million worth of business this year and \$650 million next year. Funding for the division alone was running at a rate of \$23 million annually.
- F-105 orders amounting to \$24 billion will produce \$600 million of royalties for Lockheed.
- Navy P-1V production program is now under way with \$300 million funding and the airplane was a necessary to the P-1V, which needed sales of \$1 billion over a 15-year period.
- General Electric Co., in which Lockheed has a 50% interest, has a backlog contract as the USAF Big Boost program in which Aerojet-General Corp. is developing a 1 million lb thrust engine.

Lockheed, which analyzed its third quarter earnings, will have the cash from its credits to pay a cash dividend at the end of the year, but Gross said it would prefer to keep the profits to do up while the company stands in line. The next year is expected to be a difficult year.

Though the Lockheed write-off, now as it may turn out, seems large, its Electra program charges do not appear out of line when compared with other commercial jet manufacturers.

Lockheed's price charges, including restrictions amount to approximately \$10 million, based on previous company reports (NAV Mar. 2, p. 377). Douglas had losses of \$716 million in its DC-8 at the end of 1959 and Boeing \$157 million.

General Dynamics Corp., reporting its first half results last week, said its total Comstar 583,800 write-offs in June 50 were about \$180 million.

# Airline Traffic—June, 1960

	Passenger Thousands	Passenger Miles Millions	Load Factor %	U. S. Mail Ton-Miles	Express Ton-Miles	Freight Ton-Miles	Spill Revenue Ton-Miles	Overall Revenue Load Factor %
<b>DOMESTIC TRAFFIC</b>								
American	740,346	412,847	79.0	1,419,412	104,343	5,444,974	70,410,440	41.1
East	204,246	122,232	84.0	422,737	180,138	721,284	11,397,716	75.2
Capital	349,319	183,344	66.4	412,416	305,121	582,201	14,120,320	32.3
Continental	123,881	74,242	63.7	181,572	197,676	486,136	12,199,400	43.8
Delta	212,271	172,820	82.7	127,474	238,479	1,499,437	18,726,676	37.7
Eastern	448,349	244,477	54.56	448,107	488,107	1,281,588	34,167,840	42.76
National	199,222	120,280	60.4	185,210	74,388	706,744	16,497,270	30.1
Northwest	148,722	94,894	64.1	122,679	29,199	327,771	3,875,832	33.8
Southwest	102,495	107,864	84.4	452,714	104,572	1,351,438	18,608,440	34.4
Texas World	479,222	462,449	72.8	1,444,816	179,749	2,367,176	48,176,280	37.7
United	750,322	472,240	72.1	2,004,430	179,140	4,234,584	44,449,440	41.8
Western	180,434	89,737	50.5	814,736	61,844	579,444	1,347,911	31.5
<b>INTERNATIONAL</b>								
American	5,846	5,281	90.5	12,427	472	254,904	1,146,440	41.1
East	5,102	4,281	84.0	10,242	5,422,810	181,292	5,422,810	38.3
Continental	20,401	3,204	16.4	1,887	1,202	304,730	47,400	27.4
Delta	2,167	4,214	194.8	6,805	33,308	351,729	47,400	47.8
Eastern	28,407	38,744	136.4	46,432	179,432	2,842,261	41,719	41.9
National	14,279	1,547	10.8	1,427	349	3,412	913,444	48.1
Northeast	2,481	1,739	70.1	1,722	1,400	12,476	222,919	44.8
Northwest	11,188	16,272	145.5	7,249,532	21,147	768,714	8,846,941	38.8
Southwest	8,212	9,229	112.4	27,861	21,476	1,281,627	66.2	66.2
Texas World	141,279	117,344	83.0	1,314,262	4,474	40,764,264	48,400	48.4
United	104,261	101,429	71.7	475,441	3,679,426	17,715,261	44,700	44.7
Western	20,212	13,620	72.4	1,276,244	2,202,412	16,113,916	47.8	47.8
Spokane	9,480	15,437	162.6	4,407	4,407	4,414,892	54.9	54.9
South	16,248	25,707	158.3	3,407,719	3,407,719	3,407,719	3,407,719	3,407,719
Texas World	44,441	144,105	32.2	1,102,846	1,102,846	1,102,846	1,102,846	1,102,846
United	17,214	42,212	245.3	111,234	179,720	4,641,616	47.8	47.8
Western	4,484	4,572	102.2	4,572	22,778	744,261	12.7	12.7
<b>LOCAL SERVICE</b>								
Allegany	44,774	12,741	28.5	17,741	27,740	45,478	1,416,544	44.4
Samoa	11,214	5,364	47.8	4,364	5,364	18,440	819,441	38.1
Central	12,440	3,207	25.8	1,207	2,207	9,444	217,261	28.4
Proctor	22,494	3,386	15.1	5,386	16,257	16,257	542,921	47.2
Western	89,841	12,163	13.5	17,721	21,139	16,142	2,211,840	47.2
North Central	81,188	16,622	20.5	36,622	41,610	16,142	1,416,544	44.4
South	85,204	9,264	10.9	17,868	39,272	30,440	872,209	45.9
North	44,220	10,438	23.6	17,868	6,432	1,647	1,331,644	48.7
Proctor	41,802	10,127	24.2	16,614	20,144	20,144	1,416,544	44.4
South	7,454	1,268	16.9	3,171	3,171	3,679	141,124	42.1
Texas World	30,791	7,174	23.3	32,838	12,722	40,447	742,861	48.7
<b>BALANCE UNIT</b>								
Delta	34,483	5,193	15.1	2,193	7,207	420,140	42.8	42.8
Northwest	47,496	11,122	23.4	47,126	437,345	1,881,799	44.8	44.8
<b>CARGO UNIT</b>								
American	4,490,248	6,490,248	144.6	6,490,248	6,490,248	6,490,248	6,490,248	6,490,248
Continental	1,191	4,496	379.8	32,726	34,343	6,442,173	7,622,218	47.8
Delta	39,196	39,196	100.0	39,196	34,194	1,685,891	1,161,419	75.4
Eastern	179	1,268	7.1	7,121	642,841	774,176	41.4	41.4
Northwest	3,222	8,164	253.3	474,430	5,111,713	4,471,842	72.2	72.2
South	3,417	11,494	336.4	6,490,248	6,490,248	7,438,430	302.2	302.2
<b>HELICOPTER UNIT</b>								
Chicago Helicopter	31,540	334	1.1	1,111	1,111	42,812	42.1	42.1
San Antonio Airways	3,420	122.1	3.6	4,384	1,191	17,336	30.2	30.2
New York Airways	14,194	381	2.7	1,191	1,191	42,812	42.1	42.1
<b>ASALA UNIT</b>								
American Airlines	11,241	8,931	79.5	27,276	2,407	221,928	1,474,237	47.2
American Eastern	7,610	704	9.2	4,300	1,600	40,400	40.4	40.4
Continental	1,842	204	11.1	4,310	7,310	11,732	47.4	47.4
Delta	6,240	409	6.6	2,810	1,799	42,812	42.1	42.1
Northwest Consolidated	5,712	5,142	89.9	24,741	7,449	54,711	54,711	54.7
Southwest	12,234	12,234	100.0	12,234	12,234	12,234	12,234	12,234
Southwest	1,573	1,381	88.0	20,917	64,109	244,267	49.8	49.8
Western Airlines	8,748	1,764	20.1	58,875	135,884	244,267	49.8	49.8

\* Not available.  
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## Grumman Gulfstream

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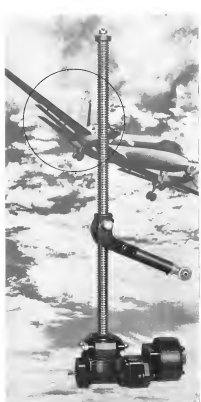
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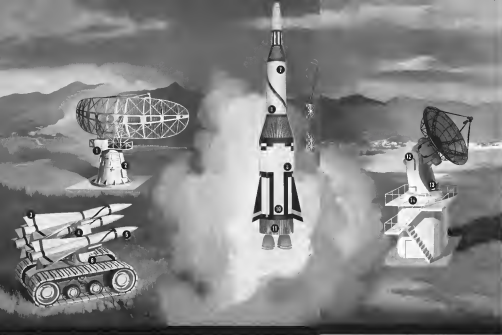
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660940 720 intermediate-range jet transport has down approach speed this previous aircraft in the 707 family.

#### Aviation Week Pilot Report:

## Performance, Response Improved on 720

By William S. Reed

Seattle, Wash.—Improved landing qualities plus increases in performance, cruise rates, 707s, resulting from extensive weight reduction and higher thrust engines, make the recently certified Boeing 720 highly adaptable to its medium-range transport role.

Flight evaluation by day aviation. We've pilot reveals that the 720 is a true medium-field aircraft capable of cruising at 600 mph with control forces and response at a level better than might be expected from a large transport. Aircraft lower was N721SA, the 12th 720 of the Boeing Airplane Co. production lot and the second of 21 ordered by American Airlines (AA) July 15, p. 47). The evaluation was performed during a three-hour check-out

flight prior to delivery, with Boeing production test pilot F. J. Silbaway as sole commander.

Gross weight of the aircraft for this flight was 55,000 lb., a relatively light loading since the model 720 can gross up to 71,000 lb. A check of the airplane flight manual showed that optimum V<sub>1</sub> speed was 120 kt., V<sub>2</sub> speed 153 kt., V<sub>R</sub> is the speed at which, if an engine failure occurs, the least-to-distant distance to continue the takeoff is a height of 35 ft., it equal to the distance to stop, and V<sub>2</sub> being the climb speed retained when reaching a height of 35 ft. Rotation speed, V<sub>R</sub>, in this case coincided with V<sub>1</sub>.

With the outside air temperature reading 50C (80F), altimeter setting of 10.83, the aircraft rolled down Boeing Field Runway 31 and reached V<sub>1</sub> speed

of 120 kt. in considerably less than 5,000 ft. Under similar ambient conditions at its maximum gross weight of 71,000 lb., the handbook shows that the 720 would have required a balanced field length of about 9,000 ft. The FAA defines balanced field length, which is not necessarily runway length, as the horizontal distance required from takeoff roll to reach an altitude of 35 ft., assuming an engine failure at V<sub>1</sub> speed.

Speed of 153 kt. was held during gear retraction and throughout the second and third segments of the climb. Climb speed then was allowed to build up to about 160 kt., or 175 V<sub>R</sub> total, at which point flaps were retracted. Power was reduced after climb speed of 208 kt. was reached, the exhaust pressure ratio read 2.3 with V<sub>1</sub> (first compressor) showing 95% rpm. Even at this reduced



ADDITION of 49 in. to the vertical fin was made to obtain better directional control during engine-out operations. At right, dark portion on wing, with fairings, outlines the leading edge glove. Note forward wing and control surfaces at aft position. Leading edge flaps on the wing serve to fill gaps left by effect of engine failure when flaps are lowered.



power setting, the aircraft was climbing at a stabilized 3,000-plus fpm when passing 5,000 ft.

The test mission required that the aircraft be flown at cruise speeds of 18,000, 20,000 and 21,000 ft. cruise air level. Functional tests were given to the aircraft systems and checks were made of trim, setting of a variety of accessories. Throughout all speed ranges, the 720 exhibited good handling qualities and demanded only a normal amount of trim change as the speed varied. Amount of trim change necessary, however, is somewhat greater than that in the 707, possibly due to the higher thrust Pratt & Whitney JT3C engines and the shortening of the tail moment arm resulting from an overall 80-in. reduction in fuselage length.

Of particular note is the improvement in handling about the vertical and longitudinal axis which results from installation of a full-blown rubber and surge tank in the aileron system. Not only does the boosted rubber effect a considerable reduction in pedal forces, but a 45 in. cap on the vertical fin provides better directional control during critical engine-out maneuvers at low speed. The vertical fin, however, is of shallower depth than on the 707 120 or 120 models owing to the necessity for increased ground clearance at high angle of attack landings. The 720's vertical fin is approximately 19 in. in depth compared with 30 in. for the earlier models.

Improved lateral control results from modification to the aileron control system which channels the aileron deflection into the wing. Not only was the linkage redesigned but the mechanical design of the aileron control tab system was refined. Lateral control at high speed is obtained by a pair of inboard ailerons, while low speed control is effected by an additional pair of inboard ailerons which are used when flaps are lowered.

Four pairs of hydraulically-actuated spoilers, positioned in a follow-up valve, augment the ailerons.

Spoilers can be automatically deployed by a go/no-go level in air traffic control system for deactivation in air speed brakes for deactivation in air speed brakes. In addition to providing a controlled deceleration similar to that experienced in landing speed brakes in a jet fighter, the spoilers produce a slight sweepback pitching moment which can be utilized to offset longitudinal control in the event of a general instability.

Maximum cruise speed of the 720 has been boosted by Mach 0.87 by the incorporation of a leading edge glove. Speed increases, which amounts to about 12 kt., is achieved at no increase in cruise thrust so that effects of the glove take full advantage of the aircraft's improved engine and the speed increase occurs in a benign path to achieve 1,000 ft. in air atmosphere.

The leading edge glove reduces drag directly, allowing an increase in cruise speed, in effect.

- Increasing the angle of wing sweep.
- Decreasing the thickness of the wing near the root.
- Bringing forward the point on the wing chord at which flow separation takes place by sweeping the inboard ailerons, point forward.

The glove, or leading edge extension is not a structural part of the wing but sits in the slots of a fairing. Had the wing structure been redesigned in such a way as to form a part of the glove, the wing would have had to be lowered on the fuselage at a height incorporated in the cabin floor. Boeing engineers wanted it not so that the original wing skin and structure is retained for strength and the glove structure is constructed in air to pick up loading or twisting loads between the wing and fairing. Leading edge versions of the glove are made of metal to withstand the effects of wind and heat stresses but the aft portion is fabricated of glass fiber for lightness and rigidity.

Boeing also underwent theoretical and wind tunnel investigations on other types of drag reduction devices such as wing "anti shock" boxes, but decided these in favor of the glove. Data showed that while the wing boxes delay the drag rise above Mach 0.85, they could not drag down the glove arrangement. Thus, speed was lower. Final decision was that the glove, though the JT3C-7 would not be sufficient to allow the aircraft to economically maintain a high enough cruise speed to



FULL EXTENT of leading edge glove is shown by comparison of dotted line (left) which shows outline of former wing skin. Glove has more the former leading edge where aileron system are fitted. Leading edge skin is shown in full deflection position (right).

## NO DOUBT ABOUT IT—

"SCOTCH" BRAND Sandwich Tapes wear 10 times as long without errors

IS THAT NARROW LITTLE LIFELINE OF DATA known as magnetic tape, a mass as susceptible as a mole? A missed bit, an error picked up by error-correcting, frustrating and time-consuming. If you're in doubt about the kind of performance you're getting, perhaps "SCOTCH" BRAND Sandwich Tapes can solve some of your tape and equipment problems.

The exclusive construction of the Sandwich Tapes combats the causes of error because it eliminates the source-once rub-off and hand build-up. Tests prove it wears a minimum of 10 times as long as ordinary tapes before it errs. As a by-product, you can rely on it to drastically reduce maintenance and replacement costs on equipment.

The Sandwich is constructed as shown in the diagram at the right. The famous "SCOTCH" BRAND high potency oxide coating is sandwiched between a tough polyester base and a 30 micro-inch layer of plastic. Since the oxide is never in contact with the head, tape movement is smooth and low in friction—easy on both tape and equipment. Oxide can't rub off and doesn't wear down.

Yes, the real merit of this remarkable Sandwich is the "SCOTCH" BRAND high potency oxide coating. Even under the protective plastic, the oxide's potency is quite sufficient to pick up 100 pulses per inch—and give desirable high-frequency response in many AM, FM and PCM applications. Sandwich Tape is but one of the developments to come out of JMI research—the same research responsible for "SCOTCH" BRAND Video Tapes—the first video tape in commercial use.

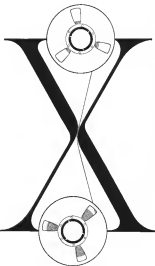
Whenever your application—you find the right tape for reliable, error-free performance is the "SCOTCH" BRAND loop-loop. Check them all: High Resolution Tapes 128 and 159 pack more bits per inch, offer either standard or extra-play time. New Heavy Duty Tapes 198 and 199 offer good resolution and exceptional life even in poor environments. High Density Tape 128 gives top output in low frequencies, even in temperature extremes. And Standard Tapes 208 and 196 remove the standard of performance.

Your JMI Representative is close at hand in all major cities—a convenient source of supply and information. For details, consult him or write: Magnetic Products Division, JMI Co., St. Paul 6, Minnesota.

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avoid the last speed penalty of the anti-shock bodies.

Cruise speed situated at 15,000 ft VMS, was slightly over 100 kt. At this speed, the 730 is an excellent Mach 0.75 which would put it in the 100-110 kt. airspeed region. At this speed, the 730 is about 20 deg. steeper than standard. The tape stopped near out to 391 mph, which compares favorably with Boeing's claim of 600 mph cruise. Half the temperature, less at standard, or if these are data, are reduced to stand and the true speed would work out to approximately 300 mph.

At the above speed, the 730 handled air well. It didn't have any, particularly pleasant and the thrust operated almost free in comparison to the standard. The flight was with a number of engine running back and forth in the cabin. An anti-shock large aircraft though the weight, in this case, a 730-200, does a far better job of flying the aircraft and will no doubt be so unified.

### Still Working Reduced

Additions of the leading edge flap has caused a loss in the amount of still working buffer on the 730, but at the same time, it gives a more stable wing edge which helps to the full speed and the cost of buffer. Boeing has decided it is feasible to install a shock absorber on the aircraft to replace the still working of buffer. It may be that the modification, built into the aircraft, however, would be identical to those of the original 730 series, with the aircraft flying through straight ahead and no more accomplished in a straight forward manner.

The addition of leading edge flap results in an approximate 20% increase in lift coefficient at takeoff and an approximate 14% increase at landing. There are four types of leading edge flap which help to the full speed position when the flap is fully extended. The flap is fully extended 30 deg. Leading edge flap on the 730 resembles flat plates and serve to increase the effective camber of the wing at low speed. The actual flap with the lower wing surface, when the main flap is extended beyond 30 deg.

Boeing engineers say that these leading edge flap were clearly in the full speed flap. Although they extend out only about half of each wing span. The engine pilots, they explain, serve as the leading edge flap. The flap, as it is, and the leading edge flap, were used as the "dual light" prototype 730. In this configuration, was accepted. Tests in flight determined that leading edge flap outboard of the pivot contributed little and so

were not incorporated in the engine, main program.

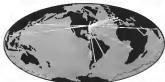
A 730-200 was brought back to the version of Seattle and the descent for landing was made. It was determined that the landing gear weight would be 110,000 lb. At this weight, the stall speed will fall 30 deg. flap is 90 kt., and the book shows the landing reference speed to be 115 kt. (the FAA shows landing reference speed in the speed at the 50 ft height in a normal landing. The speed must be equal to 1.1 times the stall speed in the landing configuration).

When the Landing gear was lowered and the flap extended to 30 deg. the

aircraft was down at 340 ft. in the landing pattern. Control about 1300 ft. was needed and was particularly great physical effort was needed to make the aircraft the smooth take was required. As indicated, the flap was extended 30 deg. and the aircraft slowed to 125 ft. Again, even at this low speed, control was good. Of particular note was the very good adverse response which came during the first approach.

Troubleshooting occurred in a non-high attack, with the aircraft passing through 100 ft. and the nose was held off with no difficulty. Because there was applied after the nose wheel

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smooth the ground and turnoff was accomplished at mid-field with a minimum of braking. Had a "maneuver" drag been required, system could have been fully deployed and maximum braking used for its turnoff in a much shorter distance. The technique used on most jet aircraft for maximum distance landing also could have been employed without any north three-point touchdown to get the main wheel on the ground after which spoked wheels have been deployed, were thrust used in the reverse and full braking action applied for the shortest possible ride. Under these conditions the 720 could have been brought to a stop in about one-third the length of Boeing Field's 30,000 ft runway.

Boeing describes the 720 as the first member of the second generation of a family of jet transports. First orders are on the books for 215 aircraft plus 25 jet-transport orders. Of these 215 aircraft 70 are for carrier use, 70 for 730B aircraft, 1200B aircraft will be fitted with the P&W turbofan engine. Delivery of the 215 aircraft will occur in May 1962 with the unannounced orders following.

### Potential Market

Boeing sales department is very optimistic about the potential market for the aircraft and expects to be delivering deliveries of the original 707 family until at least 1970. This may in fact not be a realistic estimate.

All models of the 707 series aircraft are being produced simultaneously at the Boeing production line. Models include the 707-120, 720B, 720, 720-400, 470 and the 720 and 720B. Some contractors still court in the airline industry are what to call the 720 with some companies calling it the 707-720 and some referring to it simply as the 707.

Again, to produce the various size airplanes on the same assembly line as a result of what Boeing calls "rubber tooling." This permits the use of most of the same jigs and fixtures in production; the various models and models from planning for the construction of a family of aircraft from the beginning. In the 720, approximately 70% of the parts are common with the earlier, previous 707.

One example given by Boeing of the "rubber tooling" concept is the production of jet engines designed so they can be produced in a variety of sizes and weights by the same tooling working methods constant and turning the amount of material around. In some cases, extrusion of the same size are used and the cuts used to lighten the structure instead of turning the wing structure for lighter gross weights than needed.

Another major change is in the design

traders were landing gear truck which has been lightened. Now, the maximum takeoff gross weight is nearly 100 tons less than that of a 720, considerable weight has been saved by reducing the diameter of the oleo strut from 30 in. to 8 in. and by using another item, 48 x 18 instead of the 48 x 16 ones on the larger aircraft.

The shorter cabin length 36 ft 6 in. compared with 104 ft 30 in. in the 720, plus increased seat widths, also has shortened the need for one of the three turbo-compressors used in cabin pressurization. Two units are used in the 720 located in the leading edge of the adjacent engine pylon. As a back-up measure, bleed air from the first stage compressors of all four engines is available to supplement the output of the cabin oxygenation.

### Certification Completed

Certification on the 720 was completed on June 30 and the aircraft got into service on July 5. A complete certification program was run on the aircraft as it went in currently new design. Each inspection was the functional and reliability phase of testing which was run from 100 hr to 12 hr because of

the similarity with the 707 family. The 720 is a General-West Coast airplane, Boeing salesman say, but only a marginal cost to each transport unless added fuel tankage in the center section is installed (as is planned by Irish Interair and Airline). With the added tanks installed, the payload must be reduced, cutting down on the original maximum load factor economies which are the basis for the aircraft concept.

### Additional Refinement

Several refinements are incorporated in the 720 as a result of the reliability program Boeing conducted on all its jet transports in service. The average amount of accidents during, among its inspection methods and the elimination of trouble spots which arose as aircraft refinements increased are among the benefits 720 customers will find. Thus, as 720 refinements are not available in sufficient quantity to form a valuable trend the work on the transport's service, but judging from 707 statistics it should be high. Boeing now says that this refinement on all aircraft in service averages 5.5 hr, with Commercial Airline, achieving the high fleet time of 11.5 hr per day.



## Titanium Blanking Dies Save Time

Steel rule dies, introduced this year at Chance-Vought Aircraft, Inc., in Mending and pressing titanium alloy parts of titanium, steel and aluminum, are credited with saving time—time saving totaling more than 350,000. On average titanium parts, a wing of 20-47 mm diameter per part is being reduced. The punch is a flat steel die stock shaped to the form of the part to be made and placed in a wooden form die support. The titanium part is then pressed into the form of the part by the steel rule die supported on the table.

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## Inertia Platform To Test Flight Motions

Los Angeles—An inertia measuring platform will be constructed for Air Research and Development Command's Flight As Development Division of Edwards AFB, Calif., for testing controlled vibration vehicles weighing up to 50,000 lb. U.S. West's Consolidated Western Division will design, fabricate and erect the motionless test platform. Construction will begin this month and work is to be completed by December.

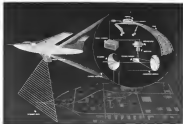
Force measurements from this test will be fed through computers and recording data will be used in determining the inertia of the plane or missile and the location of its center of gravity for studying flight characteristics and solving control problems.

The computer platform will be supported on a hydrostatic bearing set within a 16-ft-deep pit which will be excavated inside a hangar with its top at hangar floor level. Structure housing recording system will be 13-ft high by 30 ft wide and will weigh approximately 600,000 lb. Aircraft or missiles being tested will be placed in place on the platform and will be isolated on five segments of a large spherical hydrostatic bearing.

The platform will be subassembled in the company's Maywood, Calif., facility with field installation to be done under conditions by loads, using optical sensing techniques to ensure that the completed product will be a precise measuring instrument. Preliminary contract for the system was established in 1961 with Aeronautical Laboratory, Los Angeles, which contracts with WARD Corp. is also developing the measuring and plotting instrumentation.

## Joint Recruitment Program Set for Los Angeles Area

A cooperative recruitment program to attract the requirements of some 50 employer companies with the available talents of engineers and scientists in the Los Angeles area will be conducted by Control, Inc., August 23-26. Recruitment and interview needs will be established at the Science Alternatives Show and Convention. Scintilla Career, Inc., agencies was held in New York last March and resulted in more than 10,000 interviews between prospective employers and scientists and engineers. Organizations reported to be participating are: Corbin Wright, Meritt-Delmonte, Corbett (Chick), Gifford-Baker, Anger, Berne, National Aeronautics and Space Administration, Jet Propulsion Laboratory and Minneapolis-Honeywell.



## Infrared System that gives Out- standing Thermal Mapping Results

a major advance in infrared by HRB-SINGER

HRB is now permitted to discuss, outside military circles, some of the company's achievements in the field of infrared reconnaissance.

Pictured above is a schematic of the RECONOFAX® infrared system at work. Outstanding results from this system include the recently released "Manhattan Island" in which detail is accurate enough to reveal undeveloped areas in Central Park, and residential, commercial and industrial areas throughout New York City.

Data may also be collected and relayed to earth for instant viewing—a technique which will prove useful in the area of contact surveillance. Hundreds of targets can now be closely scrutinized back at field headquarters without loss of living the observation aircraft's recorded information.

Write HRB-SINGER, INC., Dept. 1, for a complete series of data sheets on HRB's RECONOFAX® systems.

**ELECTRONIC RESEARCH AND DEVELOPMENT** in the areas of: Communications • Countermeasures • Reconnaissance • Human Factors • Astrophysics • Antenna Systems • Special Systems Intelligence • Weapons Systems Studies and Analysis • Operations Research



**HRB-SINGER, INC.**  
A DIVISION OF THE GORDON MANUFACTURING COMPANY  
Belmont Park, State College, Pa.









# LOW-SHOCK TRACKED MOBILITY FOR SENSITIVE ELECTRONIC EQUIPMENT

The tactical advantages of full off-road tracked mobility in military support vehicles have been well proved in many years of field operation. But the idea of transporting intricate radar and communications equipment and fully-assembled missiles over rugged terrain raises the question, "What about vibration and shock input to sensitive components?"

The answer—favorable. Carrying a simulated missile and sensitive oscillograph recording equipment, an FMC tracked vehicle ran a 2,000-mile shock test over our proving ground—on 60° slopes, over rough cross country terrain, and on high speed roads. Data returns showed that the vehicle's torsion suspension system effectively shielded the missile, with a low shock input factor.

For full details on these tests and other questions of adapting tracked mobility for your purposes, contact FMC, America's leading producer of military-standardized tracked vehicles.

For further information, write, wire or phone  
Preliminary Design Engineering Dept., FMC  
Ordnance Division, P.O. Box 387, San Jose,  
California Phone CYpress 44194.



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Illustrated below are the M-113 and five vehicle adaptations of this basic tracked vehicle. All of the vehicles use the same military standard equipment, including engine, power train, and suspension components, thus reducing the military logistic burden and R&D costs in weapons systems.



## FMC's Aluminum Alloy Welding Techniques Open New Horizons for Structural Applications



Machines welding heavy aluminum armor plate in FMC's Ordnance Division's shops

Food Machinery and Chemical Corporation's recently developed welding techniques make economical heavy aluminum weldments possible. High strength, low weight, gas and liquid tight construction are a few of the characteristics available through modern welded aluminum fabrication. These techniques are ideally suited to the construction of vehicles—landing craft, barges, containers—on an economically sound basis.

FMC's aluminum welding capabilities are the result of extensive research and developmental work performed in cooperation with military agencies to develop reliable, economical welding techniques for the production of the aluminum M113 Armored Personnel Carrier. Thousands of pounds of various aluminum alloys were formed, welded, machined and tested to select the best alloys and fabrication methods. Over a score of prototype M113's were thus constructed and subsequently tested by military agencies to substantiate the vehicle's design and construction.

The economy realized through FMC's development of welding and fabrication techniques is an important factor—making the cost of the aluminum M113 competitive with the M48, its steel predecessor. Welding costs for this all aluminum vehicle were reduced through the use of—

- Optimum joint geometry
- Maximum use of welding fixtures
- Maximum use of automatic plate preparation equipment
- Maximum use of machine welding equipment
- Maximum use of extruded shapes

These modern methods and facilities may provide the answer to your problems in procuring high performance equipment.

The new aluminum welding techniques developed for the M113 program and vehicle production, illustrates FMC's fully integrated capabilities and facilities.

Got Critical Applications?  
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# A-L Vacuum Melted Steels and Alloys

Greater cleanliness

Improved soundness

Decreased gas content

Enhanced mechanical properties

Superior hot and cold workability

Greater homogeneity (Less anisotropy)

✓ Better quality in the finished part, properties to withstand severe manufacturing processes, fewer rejections—these are some of the cost savings of vacuum melted materials from Allegheny Ludlum.

A-L vacuum melted steels and alloys are specified for really critical applications—places where their improved metallurgical and mechanical properties get a chance to go to work. Aircraft and missile designers find vacuum melted alloys especially useful in solid fuel rockets, and in the turbine and jet engine fields. Other important uses are critical parts for machinery and chemical processing equipment.

Low alloy steels, bearing steels, stainless steels, and high temperature alloys all take on new value when

vacuum melted at Allegheny Ludlum. These steels and alloys are available in all commercial mill forms—plates, sheets, strip, billet, bar, wire, tubes, and even extrusions.

Three different vacuum melting processes are used at A-L to provide you with the exact properties you need at the lowest possible cost. For more information on A-L's vacuum melting processes and their advantages, write for your copy of the new booklet, "Modern Melting at Allegheny Ludlum." It contains technical data on new melting techniques and the quality improvements in alloys. Allegheny Ludlum Steel Corporation, Oliver Building, Pittsburgh 22, Pennsylvania. Address Dept. AP-8.

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PIONEERING on the Horizons of Steel



1229

## FINANCIAL

### Some Profits Reverse Downtrend

Signs that the generally downward trend of earnings in the aerospace industry may be slackening are evident in first half results of Boeing Aircraft Co. and Grumman Aircraft Engineering Corp.

Though Grumman and Boeing showed improvement, this has not become an industry-wide pattern. United Aircraft Corp. reported first half earnings well below last year's.

No technological or product pattern reflected the first half results, except that improved earnings generally reflect the final phases of work shifts and were down for commercial projects.

MacLean Co., for example, continued to show sales and earnings improvement from its predominantly steady programs (ENR Aug. 8, p. 117), but Lockheed Chemical Corp., which has taken the crest of the rapidly growing solid propellant rocket wave, reported a 99% decline in net earnings for the period.

Major reason for the Lockheed decline is that sales from Thiolon Chemical to Thiolon rocket operations are down because of the type of propellant in the Minuteman first stage Thiolon is developing. This stage uses a peroxide drive system and pulverizes that Thiolon Chemical doesn't make—oxide materials used for other Thiolon projects—and Thiolon must buy this from other vendors. Stocks have reflected the more optimistic outlook for defense companies Boeing's stock in three quarters reached 58 a share in the last month. Other major aerospace companies have had stock price runs of various degrees.

The company results:

• **Boeing**—Sales of \$37,653,295 and earnings of \$10,260,055 or \$1.29 a share compared with sales of \$66,157,512 and earnings of \$5,778,654 or 48 cents a share for the same period a year ago. Book profits were recorded for the first time on the commercial jet program, though these were more than offset by research and development, administrative and other general expenses which are written off as incurred. Sales this year are expected to reach \$8.6 billion and the commercial programs run more on credit with less in earnings.

• **Grumman**—Sales totaled \$25,610,011, \$1.4 and earnings \$4,327,165 or \$2.85 a share compared with first half 1969 figures of \$15,165,446, \$1.541,681 and \$1.04 a share, respectively. Book profits of \$3.15 million in against \$3.43 million a year ago.

• **Lockheed**—Net sales were \$83,261,675 and net profits were \$1,736,648 or 16 cents a share compared with sales of \$80,775,912, earnings of \$2,588,505 or 61 cents a share for same 1969 period.

• **United Aircraft Corp.**—Sales of \$343,227,294 for the first half of 1969 closely approximated the \$345,512,546 total for the same period last year, but earnings fell from \$15,775,055 or \$2.35 a share last year to \$10,849,759 or \$1.46 a share this year. Company reported research and development spending rose from \$12 million for the first six months of 1969 to \$21 million this year and that resulted in a 54.5 million after-tax reduction in earnings. Book expenditures will total \$40 million for the year.



**New Scentor Engine for Blue Steel Bomb**

New Blue Steel standoff bomb (ENR June 6, p. 10) will be powered by the Portland-Scentor A-83 T-14 solid rocket motor. It has a hydrogen peroxide in two high pressure combustion chambers. Engine is a development of the General Motors.

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CANNON ELECTRIC COMPANY

of 500, disposition of 260 common shares by L. M. Schoen, officer, leaving a holding of 240; acquisition of 100 common shares through exercise of option by Susan J. Storm, officer, leaving a holding of 1,042; acquisition of 250 common shares through exercise of option by John B. Tietzel, officer, and disposition of 200 common shares, leaving a holding of 540; acquisition of 525,000 of 45% convertible debentures by Frederick T. Robinson, director, making a holding of \$14,800.

Other transactions for the period May 11 to June 10 include:

**Aviation North Corp.** Disposition of 500 common shares, the total holding for the month of March, officer, disposition of 2,116 common shares for total holding for William H. Miller, officer, disposition of 40 common shares by Joseph E. Sweeney, officer, leaving a holding of 1.

**Amper Corp.** Disposition of 9,220 common shares through exercise of option by Robert Sweeney, officer, making a holding of 1,000.

**North Instrument Corp.** Disposition of 100 common shares by Harry W. Isadore, officer, and director, leaving a holding of 1,000; disposition of 2,000 common shares through exercise of option by Stanley D. Isadore, officer, leaving a holding of 1,000; acquisition of 100 common shares by Stanley D. Isadore, officer, leaving a holding of 1,000; disposition of 100 common shares by Stanley D. Isadore, officer, leaving a holding of 1,000; disposition of 1,000 common shares by Stanley D. Isadore, officer, leaving a holding of 1,000.

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## HEADS MEAN IDEAS AT CHANCE VOUGHT



**PUT A LAB IN ORBIT.** These scientists and 470 pounds of test equipment would be carried by the space station shown above. Its "solar" would convert solar rays to electrical power. A 300-mile orbit would provide true space environment, yet avoid radiation hazards. Scientists would build a separate inventory vehicle for a point return to earth. "Biosatellite" is a concept of Chance Vought's Automation Division, and an example of the progress this organization is making in man-machine interaction for space.

**MULTI-POLARIZED ANTENNA.** A new antenna system, recently developed by Vought Electronics, provides front, dual, linear, right or left circular polarization. No need to change elements to have the polarization mode best suited to a minute or space vehicle. The Pacific Missile Range's first tracking vessel is being equipped with the multi-oriented antenna—one of more than 160 different antenna systems conceived by Chance Vought's Electronics Division.

**THERMOMETER FOR PLASMA.** Tremendous heat that accompanies the break-up of hydrogen molecules is being accurately measured at Chance Vought Research Center. Scientists are using a spectrophotograph and a scanning device to determine temperature in any part of the flame made by the Center's plasmatrons. Experiments in measuring intense heat are part of the Center's broad studies into energy sources.

**CHANCE VOUGHT**



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Consistently successful flight performance in Project Mercury confirms unsurpassed reliability of **THIOL** solid rocket motors.

Time after time, NASA's workhorse, Little Joe, has soared into space, checking out the workability of materials, propulsion and escape systems, and reaction of research animals to the environment of space flight.

Polys, Remul, Castor—solid rocket motors from THIOL's Elken and Redstone Divisions—have unfailingly provided the thrust and power for Little Joe in its developmental flights.

THIOL's record of propulsion reliability in the spatial program is long and brilliant, reaching back to the X-17 which flew successfully on 94% of its launches, and to earlier research vehicles.

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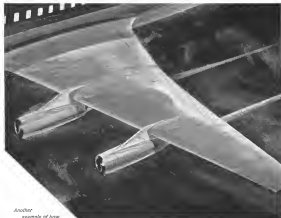
## Electronic Solutions to in-flight temperature problems

Detection and control of temperature and overheat conditions in aircraft and missiles demand highly specialized electronic equipment. Producing such equipment is the business of the Monitor and Controls Division of Fenwal Incorporated.

In this new, integrated facility, Fenwal is currently developing advanced electronic systems for a broad range of applications such as the following:

For the Electra, leading edge temperature control. For the T37, fire and overheat detection for baggage and storage areas. For the B80, leading edge temperature control, with a monitor back up system to assure that temperature does not exceed safe limits, windshield protection to guard against overheating during defrosting and bearing temperature monitoring in the air-conditioning system.

A Fenwal System can be designed and built precisely to your in-flight temperature requirements. Write Fenwal Incorporated, 128 Pleasant Street, Ashland, Massachusetts.



Another  
example of how



CONTROLS TEMPERATURE . . . PRECISELY



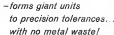
First Polaris IRBM launch from submarine USS George Washington was successful and included installation of underwater crew cabin. Because of test success, Navy expects to push for more advanced construction money during the current congressional session.

## Navy Fires Polaris IRBM From Submarine



Second and third launches (left and center) also were made from the George Washington. Navy now is working studies on installation of Polaris system in dispatch and maintenance units. Future operations would involve use of Transit satellites and Loran.

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Current WADD programs in photovoltaic (solar) cell technology include the following:

- **Improved silicon cell efficiency** is the goal of a contract with Westinghouse Electric. Theory indicates that maximum conversion efficiency of silicon solar cells is about 33%, but until recently the maximum that could be obtained in production was only around 18%. Program objective is a conversion

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efficiency of 11%, or 12% better than previously available. Progress to date indicates the objective will be met.

- Gallium arsenide cell should, in theory, provide higher conversion efficiency than silicon and be able to operate at higher temperatures. Radio Corporation of America holds a contract to investigate gallium arsenide solar cell with a program objective of fabricating cells with a conversion efficiency of 15%, a figure which presumably could be raised with subsequent effort. Progress results to date are encouraging, according to WADD representatives.
- Tuesday investigation of solar cell mode of cadmium sulfide, and study of base plates of the material, is also being carried out under WADD contract by Haskins Chemical Co.
- New cell materials, with more nearly ideal photoelectric characteristics, are shown as gallium arsenide, particularly composed and heavy materials, will be investigated by Electro-Optical Systems, Inc., Pasadena, Calif., under a recently awarded contract.
- Novel cell structures and configurations, other than the widely used serial rectangular "diodes," which would permit use of a wider portion of the energy in the solar radiation spectrum and therefore greater electrical output, are being investigated by General Electric.

- Photoelectric cell parameter study, to be carried out by Hughes Transistor Corp., Palo Alto, Calif., will seek a more basic understanding of the effects involved in solar cell operation and conversion, including such factors as cell configuration, detailed material characteristics and heating effects.
- Photoelectric studies in which solar radiation photons striking a suitable conductive surface release electrons to a nearby mode, has been a severely unexplored technology. Theory indicates that photoelectric emission should be a conversion efficiency comparable to that of photoelectric (solar) cells and such cells should be easier to manufacture to fabricate. An F-105 therefore has been a contract to Radio Corporation of America for basic study of photoelectric emission for energy conversion.
- Solar energy concentrators, which will collect solar radiation over a wide area and focus it into a small area to reduce the number of cells required, is the object of a contract with Electro-Optical Systems, Inc. The experimental lens (lens) model which the company will fabricate will provide a concentration factor of about 3:1, using reflecting surfaces which are needed so as to reflect precisely that portion of the spectrum to which the solar cell is sensitive and not the infrared portions which are only to the least the cell without producing significant output. Concentration is expected to be considerably higher

## Space Power Fundamentals

Profoundly, the energy which a unit to provide electric power for a space vehicle must come from either an external source or be stored aboard the vehicle. The sun provides the most obvious source of external power in the form of solar radiation. This can be converted into heat which in turn can be converted into electricity by a variety of means, or in photos cells can be converted directly into electricity. Solar radiation has the advantage of being "free" available everywhere in the solar system except in the shadow of a planet or the moon. In fact, it is available in an intensity of about 1000 watts per square meter at the earth's surface, which coupled with the relatively low efficiency of present energy converters, sets a potential upper limit on the amount of solar power which can be obtained by a space vehicle.

There are two basic types of energy sources which can be carried aboard a space vehicle: chemical and nuclear. Chemical energy can take the form of batteries, non-rechargeable cells, or even combustion devices which produce electricity by combustion, as in the fuel cell. Chemical energy sources usually are easily controlled and packaged, but their built-in energy limits them to short term use because of product limitations. Nuclear energy sources are basically long-lived but require extremely elaborate control systems and heavy shielding to protect other occupants in the payload from damage.

There are a variety of techniques that can be used to convert the source of energy into electricity. These include:

- Photoelectric cells, or solar cells as they are commonly called, employ a semiconductor material such as silicon which releases electrons when the material is bombarded by photons from solar radiation.
- Photoelectric emission, in which solar radiation photons striking a material cause its surface to release electrons which are collected by a nearby metal surface, such as electrons emitted by a vacuum tube cathode are collected by the plate, except that emission is produced by photons instead of heat.
- Thermoelectricity, in which voltage is developed across junctions of two dissimilar materials by the application of heat to one of the materials. Principle called Seebeck Effect (discovered in 1821), has long been used in thermocouples to measure true pressure to signal voltage at position.
- Thermionic as which first applied to a specially treated surface causes it to emit electrons which are collected at remote mode. Device operates as miniature vacuum vacuum to a vacuum tube cathode which cathode is heated directly by heat, chemical or nuclear energy instead of by electricity.
- Dynamic heat engines, in which heat from solar energy, fuel combustion or nuclear reaction, transferred to suitable working medium, drives rotating turbine or reciprocating engine that is coupled to electric generator. This approach requires more complex system and rotating machinery which makes it potentially less reliable than static conversion devices, but there is no upper limit to its power capability.
- Fuel cells, in which pure or other chemicals are combined to produce electricity through process of oxidation. Some types of fuel cells are reversible, enabling them to serve as storage devices when used with other power sources. In solar energy as power sources, for example, it can be used to decompose product of electrolysis when vehicle is exposed to sunlight. When vehicle is shaded the decomposed chemicals can be run through fuel cell to reform electrolyte to produce electricity.
- Batteries, long used for converting chemical energy to electricity, also have important capability of providing storage facilities for solar radiation collection as to handle peak load conditions. Batteries are relatively heavy for their power output and have comparatively short lifetimes.
- Plasma generators, which use conversion of hot gases and electric fields to produce electricity, has advantages of no moving parts. However, technology is only in the early stage and considerable time and effort will be required to advance techniques to operational stage.

and less costly than previous designs, according to WADD's George Shuman.

- Cell array configuration for optimum utilization of solar energy, is the objective of a study by Radio Corporation of America.
- 100 watt/100 watt power systems, using photo cells and collecting system, are being developed by Hughes Aircraft Co. to provide 100 watts power con-

stantly and 500 watts for 20 min. intervals, is the object of a design study by Hughes Electronics Corp. Company is fabricating a one-quarter scale breadboard model of the system.

Progress, sponsored by Geophysics Research Directorate with Technical Operations, Inc., is investigating new techniques for improving solar cell efficiency. One technique involves a thin film coating on cell surface



## WHERE ARE YOU IF IT DOESN'T LIGHT IN SALT AIR?

Pressure switches that only turn on warning lights in uncontaminated air find it tough going in such a simple threat as salt air atmosphere.

This may just be the problem in checking the pressure switch under stress before operating requirement... not just in a vacuum, or 85% humidity or just at sea level, far outside.

Take Model 9693 shown on right that can do no more job... operate warning lights, measure fuel and air pressure, altitude, air conditioning for electronic gear. This model, in ranges from 6 to 1000 psig, operates between -55 to 235°F, withstands shock up to 100 g's and vibration to 2000 cps. It is only 1 1/4" diameter by 2 1/4" and weighs but two ounces.

Copy an "Test it yourself for a week" under all the requirements of your job. Or even on window by clamping per own test data on a full line of pressure switches for the type that meets your needs best. Call Mr. Charles Call at Consolidated Controls, Bedford, Conn. Phone PRomer 3-9221, DDD Code 283.



Index of Water  
in Hundreds  
of Atmospheres

Model 9693, shown above, is one of the many pressure switches manufactured by Consolidated Controls. It is a high pressure switch, capable of operating from 6 to 1000 psig, and is designed for use in a wide range of environments. It is only 1 1/4" diameter by 2 1/4" and weighs but two ounces.

which would convert ultraviolet into radiations, in which the cell is not actually exposed into visible light which will produce chemical output. Also under investigation are means of generating a cell to solar radiation of longer wavelengths which can produce with reduced heating.

Both thermoelectric and thermoelectric converters are heat engines whose efficiency is a function of the difference in temperature between their 'cold' and 'hot' elements or the greater the temperature differential, the greater the conversion efficiency.

In space, the risk factor of obtaining long-term cooling is to reduce heat into space. The efficiency of the radiator is proportional to the fourth-power of its temperature. Thus the higher the temperature at which the cold-side of the converter and radiator operate, the less radiator surface is required for cooling—an important item for payload-limited space vehicles. For space vehicles, the highest possible operating temperature is therefore a major objective.

### Lower Temperatures

Because present and anticipated future thermoelectric materials operate at lower temperatures, below approximately 1,000°C, while thermoelectric converters actually operate best at temperatures above 1,000°C, the thermoelectric converter appears more attractive for space vehicle use than does the thermoelectric converter. For the submarine or deep-sea use, where no water provides an excellent cooling medium, thermoelectric converters are more attractive. This explains why Navy continues its activities in thermoelectric power (see story).

However, the combination of thermoelectric and thermoelectric converters seems attractive possibility. Westinghouse Electric recently demonstrated a combination unit in which a thermoelectric converter was built into the fuel element of a nuclear reactor where it is exposed to extremely high temperatures of several thousand degrees while the thermoelectric material enclosed the thermoelectric converter and is exposed to lower temperatures, where it operates best.

Current WU-100 programs in thermoelectric conversion are:

- **Thermoelectric generator, capable of producing 5 watts output, as being developed in General Electric with early delivery in WU-100 for evaluation tests.** Company also is under contract to provide design, material and manufacturing support and capable of delivering 100 watts.
- **Solar thermoelectric generator, in 300-watt output unit, capable with solar collector and radiator, to be designed and fabricated by Hamilton Standard**

Division of United Aircraft Corp. Initial testing is scheduled to begin the fall. Company also will design a 1,500-watt vacuum sealed for satellite use. The 100-watt system will couple heat sink of small aluminum finned, in sealed in groups of 25 on lightweight aluminum tubing, to collect and focus solar radiation on the hot end of the thermoelectric generator.

- **Portable space power, where using two thermoelectric generators to generate supply electric power will be developed by Westinghouse Electric using two 100-watt models.** Company also is under contract to design, develop, produce and test a thermoelectric power program under Navy sponsorship.
- **Geophysical Research Directorate has several programs under contract in the field of thermoelectrics.**
- **Thermoelectric-electric effects—of magnetic fields on thermoelectric characteristics of semiconductor compounds—made study by Laboratoire Central de France, Lebanon, in conjunction with some studies on fresh in magnetic domains equivalent to 100 gauss. Work to date indicates that magnetic field sometimes enhances thermoelectric effect, sometimes reduces it, but the basic physics of the effect is not well understood.** New thermoelectric is working in this field under CRD contract.
- **New materials investigation is under way at New York University.** Work includes investigations of large photoelectric voltages reported for crystals and epitaxial layers of compounds made from zinc and Group IV elements. University also is investigating thermoelectric properties of organic oxides, alloys and semiconductors.

The complex type of thermoelectric converter, called the close-spaced diode because its two electrodes are separated by only a fraction of a thousandth of an inch, operates in a novel way. It is a solid-state device that utilizes a thermoelectric effect in a solid-state material. Important discovery in this device comes from results from direct application of heat, and the device must be maintained at a cooler temperature, whereas in a diode converter electrode is heated by electron flow. This device has been developed by the Radio Corporation of America (RCA) and is being developed by RCA. It is a solid-state device that utilizes a thermoelectric effect in a solid-state material. Important discovery in this device comes from results from direct application of heat, and the device must be maintained at a cooler temperature, whereas in a diode converter electrode is heated by electron flow. This device has been developed by the Radio Corporation of America (RCA) and is being developed by RCA.

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less thickness when bombarded by electron radiation from the cathode. The close-spaced diode employs electron-coupled fields to maintain space charge balance. Because the field can be used to accelerate electrons, the diode can be separated by greater distance, minimizing radiation heat loss from cathode to anode.

- **Benefits of thermoelectric conversion are under way at WU-100, or proposed, include the following:**
- **Close-spaced diode, capable of developing 100 watts output, is being developed by General Electric. Contract signed with agency for development, project Agency, subsequently transferred to Air Force for marketing.**
- **High temperature, gas-filled diode, designed to operate at temperatures of 1,700 to 2,000, which is obtained by electron radiation, is being developed by RCA. It is a solid-state device that utilizes a thermoelectric effect in a solid-state material. Important discovery in this device comes from results from direct application of heat, and the device must be maintained at a cooler temperature, whereas in a diode converter electrode is heated by electron flow. This device has been developed by the Radio Corporation of America (RCA) and is being developed by RCA.**
- **Solar powered diodes, one close-spaced type and one gas-filled type, each capable of delivering 100 watts, will be fabricated by RCA and RCA. RCA will develop a diode which will be used for a solar thermoelectric power system with output in the 100 to 1,000 watt range. WU-100 plans call for a program in the development of close-spaced diodes under the coming year.**

Research programs in thermoelectric conversion have been sponsored by the Geophysical Research Directorate. The Geophysical Research Directorate is a part of the Radio Corporation of America (RCA) and is being developed by RCA. It is a solid-state device that utilizes a thermoelectric effect in a solid-state material. Important discovery in this device comes from results from direct application of heat, and the device must be maintained at a cooler temperature, whereas in a diode converter electrode is heated by electron flow. This device has been developed by the Radio Corporation of America (RCA) and is being developed by RCA.

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## Radiosonde Dispenser

In simplified maintenance, the dispenser is a solid-state device that utilizes a thermoelectric effect in a solid-state material. Important discovery in this device comes from results from direct application of heat, and the device must be maintained at a cooler temperature, whereas in a diode converter electrode is heated by electron flow. This device has been developed by the Radio Corporation of America (RCA) and is being developed by RCA.

## Instrumentation and Controls

Consolidated Controls, Inc., is a solid-state device that utilizes a thermoelectric effect in a solid-state material. Important discovery in this device comes from results from direct application of heat, and the device must be maintained at a cooler temperature, whereas in a diode converter electrode is heated by electron flow. This device has been developed by the Radio Corporation of America (RCA) and is being developed by RCA.

For complete information on the full line of products of The Consolidated Controls, Inc., call Mr. Charles Call at Consolidated Controls, Bedford, Conn. Phone PRomer 3-9221, DDD Code 283.

**THE CONDEC GROUP\***  
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EXCELLENCE IN ELECTRONICS



# SPACE TECHNOLOGY

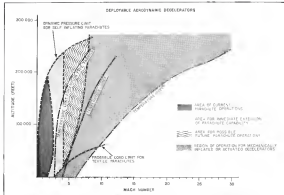


CHART shows by Aerodynamic Decelerator French scientists show area of contact and anticipated decelerating devices.

## Drag Devices Studied for Recovery Units

By Michael Yaffee

Thermos, Ohio—Infinite lobes, suspended umbrellas, and wire mesh parachutes are some drag devices now under consideration for possible use in future Air Force high speed, high altitude recovery systems for doctors, doctors, military vehicles and special ops units.

Possibly the greatest current need in this area is for an aerodynamic decelerator that can bring a vehicle from hypersonic to subsonic and at the same time provide precise landing point control, all done at a cost in bulk and weight comparable to that of a parachute.

A system such as this will probably employ lift as well as drag and, scientists believe, will take a long time to develop. Meanwhile, they say, there is still much to be learned about the operation of the ordinary parachute and other devices that are expected to provide the deployable landing deceleration.

Currently, the Aerodynamic Decelerator Branch of the Wright Air Development Division here is studying a variety of devices in an effort to complete the data needed to narrow the gap between reliable performance and recovery capability. All these devices have one thing in common: their operation depends upon their interaction with the molecules of air available in the atmosphere to create drag as opposed to the operation of devices such as retro-rockets.

Work under the Aerodynamic Decelerator Branch falls into three broad categories: constant area drag devices, variable area drag devices and devices in which drag is supplemented by a small amount of lift. Still the most important type of constant area drag device is the parachute, which provides most drag for a given amount of bulk and weight than any other sort. The parachute still possesses a significant potential for improvements, ADDB scientists say.

Currently self-inflating parachutes will operate up to approximately Mach 2.5. ADDB believes it can extend the operational capability of parachutes to Mach 4 in the near future. There is no agreement at the present time for parachutes beyond Mach 4, but ADDB scientists George Selt and Basil Berrell believe that eventually it may be possible to develop parachutes which will function at velocities up to Mach 5.

The magnetic parachute is still in the early stages if ever it reaches the hardware level, adds one that it won't lose. Like a parachute or even fall into the category of constant area drag devices. At the moment, ADDB researchers are simply pondering how supersonic devices might fit into the picture.

One thought, for example, is as the penetration of a magnetized, slotted metal device similar to a balloon, inflation possible that might be deployed in the atmosphere and slowed down by interaction with the ions that flow through it. Another thought concerns a magnetized, variable area drag brake type device that might interact with the ions formed in the wake of a reentry vehicle.

To push the operational capability of parachutes to Mach 4 scientists must overcome a number of problems. One is the phenomenon of rotating shock waves, a problem also encountered in the development of swept wing aircraft. Air Force scientists first tests, with contact with this problem with the basic fabric, ribbon parachute at Mach 1.5. They solved this problem, as more recently detailed in, said March 7, by altering the geometry of the inflating shape, adding a skirt among other things, and by increasing the porosity to induce air to flow and outflow.

The best, ADDB is taking a longer approach to the problem and, working with University of Minnesota and Cook, Research Laboratories, is obtaining data on opening shock, opening boundaries or squalling, pressure distribution on canopy, strength distribution, material changes. In addition to solving the shock problem, ADDB—much on the way to decreasing bulk and weight—needs to see if parachutes are being over designed, also what high temperature materials will serve best in high speed recovery.

For speeds above Mach 1, ADDB believes aerial textile (woven) parachutes will be required. ADDB researchers first started thinking of the deceleration requirements of space flight in terms of large parachutes with inflatable rings that could be built into the chute to form the parachute area at high altitudes. But operational wind tunnel tests in 1950 gave them that first view of the rotating shock problem that very to counter above Mach 1.5, and another look at the temperature regime showed them they could expect trouble from inflated no person less. Also the weight penalty of strong materials high temperature stability in recovery for each suspension line appeared prohibitive.

It was possible for these reasons that ADDB researchers started thinking in terms of balloon decelerator devices. So they have tested pressure inflated balloons in wind tunnels up to speeds of Mach 1.5, and they now are running low flight tests of balloon decelerator devices using C-119 aircraft which will use the device to speeds of Mach 4 and altitudes of 150,000 ft. The first device will be Goodhue Aircraft Corp. a British version in which balloon deceleration is implemented by a parachute ejected at lower altitudes (AVIATION WEEK, p. 67).

At present, balloons implemented deceleration last, pressure for the Mach 2-10 range. For the time being they are still in the constant area drag category. That drag efficiency (weight/drag ratio) is not in good shape for the parachute of a Mach 4 parachute is developed, use of balloons would probably be restricted to the Mach 4-10 range. Principal advantages of the balloon are that it can be easily inflated, that it avoids the rotating shock problem encountered by parachutes at relatively low Mach numbers, and that it has only one main suspension line, which if necessary can be made out of steel and gives a redundancy coming with a comparatively small weight penalty.

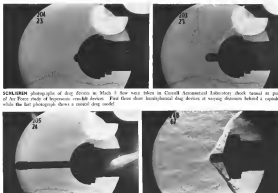
Variable area drag devices come into the picture with the requirement for decelerating manned recovery vehicles. Studies showed that dropping the use of constant area drag devices didn't alter the maximum deceleration load a recovery vehicle would generate, only the altitude at which it was generated. On the other hand, ADDB researchers found that the maximum load could be reduced significantly by varying the drag area—starting at high altitudes, for example, with a maximum drag area, gradually reducing the area and then increasing it again for the last landing phase. The Air Force awarded General Anemont Laboratory, Inc., a contract for the investigation and study of hypersonic aerodynamic devices which could be used in the recovery of a space vehicle reentering the earth's atmosphere. (Hypersonic is generally used in referring to velocities above Mach 5.)

The laboratory worked Phase I of the program only last year. This was mostly an analytical study in which it

into the study to form the parachute area at high altitudes. But operational wind tunnel tests in 1950 gave them that first view of the rotating shock problem that very to counter above Mach 1.5, and another look at the temperature regime showed them they could expect trouble from inflated no person less. Also the weight penalty of strong materials high temperature stability in recovery for each suspension line appeared prohibitive.

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SCHEMATIC photographs of drag devices in Mach 3 flow were taken in General Anemont Laboratory shock tunnel at part of Air Force study of hypersonic drag devices. First three show longitudinal drag devices at varying distances behind a capsule, while the last photograph shows a conical drag device.

postulated a number of re-entry vehicles, drag devices and flight paths and thus calculated various re-entry parameters. Among the conclusions reached by Carroll scenarios are the following:

- In the case of fixed area drag devices, minimum peak deceleration is achieved with a drag/wright coefficient of 9.1 for the entire vehicle.

- Variable area drag device which maintains constant deceleration will produce lower deceleration and heating during reentry than a fixed area drag device.

- Optimum re-entry paths for variable area drag devices are obtained with an initial drag/wright value of 8.5 and entry angles to  $-1$  deg or a drag/wright value of 1.9 and entry angles to  $-2$  deg.

- Change in re-entry altitude from 400,000 to 100,000 ft has little effect on re-entry parameters, but changes in lower altitudes do have a significant effect.

- Use of a device with a large drag-to-weight coefficient to initiate reentry from orbit appears feasible if increased ranges and flight time can be tolerated.

Now in Phase II of this program,

CAL is testing models of several different drag device shapes in its hypersonic shock tunnel (AVT Jan 22, p. 64). Among other things the scientists are measuring drag, lift, pitching moment, heat rates and pressures at various points. This phase is now drawing to a close and a final report is expected before the end of the year.

#### Avco Drag Brake

Some time ago Avco Corp. sent Air Force an unsolicited proposal for a variable area drag device that would have the additional advantage of being able to initiate re-entry from orbit without the need of a retrorocket (AVT June 22, 1979, p. 61). The Avco drag brake also was said to provide landing point control to within plus or minus 100 naut. mi. Each time, Avco secured a WADD contract covering both study and demonstration of the feasibility of its particular variable area drag concept.

The problem of landing point control has become more and more pressing, according to ADP. Single burning

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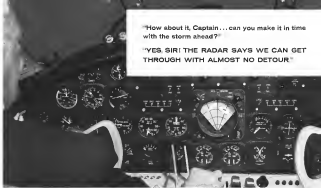
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**GOODBYE** Avco Corp. drag balloons probes a hot reentry spot as it enters. The balloon is capable of being inflated to a diameter of 9 ft in a time span of only 0.4 sec.



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**WIND TUNNEL** model propeller was adapted to represent a conventional airfield prop to measure air performance losses when the prop was in a low camber cruise configuration. Hamilton Standard reports that the performance penalty of the good blades is negligible. The company's relatively designed wind tunnel model did not perform well above Mach 5 due to relatively thick blades.

## Variable Camber Prop Studied for VTOL

By Barry Toth

Windows, Locks, Cores—Variable camber propellers capable of changing effective blade camber in flight to provide wind lift-lift lifting to takeoff and cruise flight regimes, will be developed by the U.S. Navy.

The propeller, designed by Hamilton Standard Division of United Aircraft Corp., will be developed with a Navies Corps VTOL program in mind. Previous applications for the air propeller design will be for lift wing or lift engine VTOL designs; however, Hamilton Standard says that substantial benefits may be gained with the propeller in high speed (Mach 6 to 10) conventional high-speed transports.

### Design Goals

The variable camber propeller is an attempt to solve the conflicting lift drag requirements of takeoff and cruise, which, along with weight, place the most stringent constraints on propeller design. Unable to coast to three, takeoff and cruise wing designs, propeller designers must compromise, usually sacrificing prop efficiency to meet either lift or cruise performance goals. The design thrust demands, critical with conventional propeller designs, increase above Mach 6 and with VTOL vehicles with lower cruise requirements.

The new prop design is called a tandem variable camber propeller. The company's test model consists of six, airfoil-tipped blades mounted in tandem pairs about the prop hub in the configuration of a three-bladed propeller.

The takeoff or high camber configuration, the blades are twisted to 30°, to effect three high camber blades. In maximum cruise efficiency, blade angles are adjusted to provide six low camber blades mounted in tandem pairs. The six, one, larger innermost blade at blade tip prevents a net camber twist spacing between prop blades.

### On-Stream Twist

In addition to VTOL applications, the Navy is considering use of the variable camber prop to increase the cruise thrust of advanced jet-wing aircraft. Here, the variable camber prop would be used not to gain static thrust on takeoff, but to minimize fuel consumption at cruise. An aircraft such as the Convair W-12, early warning plane, with engines at low power settings and props of low camber, would be capable of "loitering" at low speeds with maximum fuel efficiency, thus increasing on-cruise time.

The present Navy contract for the development of the variable camber propeller totals \$518,000. The contract development from the present wind tunnel model to the point where a prop can be designed for flight testing.

Hamilton Standard's initial contract to develop the tandem variable camber propeller is in three stages.

• **Wind tunnel investigation** of two-dimensional airfoil sections will provide basic data necessary to design a variable camber prop of maximum efficiency. All work thus far has involved an inherently designed wind tunnel model intended only to prove the

feasibility of the tandem variable camber concept. The first step of development should suffice such basic questions as individual blade camber, relative blade size and blade spacing.

• **Model propeller**, designed as the basis of stage one research, will be built and subjected to wind tunnel tests. The efficiency of this model will be measured at high and low camber and at varying air speeds. An interference effect while operating at low camber also will be studied.

• **Full scale blades** will be constructed for wind tunnel comparisons of structural stress and vibration. Third stage will be conducted measurements with the first test.

### Full Scale Prop

Construction of a full scale propeller for flight testing will not take place until completion of the initial contract, scheduled to run 14 months. The variable camber propeller has been under study at Hamilton Standard since 1958.

George Rosen, Hamilton Standard's chief of aerodynamics and the director of the company's variable camber propeller design, comments that "2-24" can be required before the propeller is flight tested. Rosen says he let open the tandem variable camber prop concept after considerable thought on a single propeller blade. Propeller designs have always been unimpaired in wing shape, which have simply the combining high lift high speed requirements of aircraft wings. The high rotational forces acting on propellers,

however, limit them. Staggered efforts to design variable speed control blade tips.

Rosen said considered lifting the blades and providing a separate movable flap action to the blade camber. This appeared impractical but it was to bridge the gap between the longitudinal blade and the joint tandem blades of the tandem camber propeller.

After testing with small models to compare tunnel and Hamilton Standard that the tandem blade geometry was feasible, Rosen and his staff designed a wind tunnel test model. This 2.5 ft diameter test propeller was tested in the United Aircraft Research Laboratories wind tunnel at East Hartford, Conn.

The project of the company-sponsored wind tunnel program was to confirm the capability of the tandem variable camber propeller to provide substantial efficiency, camber twist without producing cross performance. The test model consisted of an eight-blade model mounted on a 7 ft diameter hub to match the test rig. Aspects in the program covered a Mach range from zero to 0.2 in the 18 ft throat section of the wind tunnel and from 0.3 to 0.6 in the 8 ft throat section. The model was tested in tandem, variable camber and for purposes of comparison at a conventional unbladed propeller.

### Thrust Increase

The wind tunnel feasibility test demonstrated a magnitude of static thrust increase to be equivalent to that achieved by an increase in integrated disk lift coefficient from 1.22 to 2.0, a conventional propeller. Cruise performance on the model was shown to be equivalent with effect the conventional airfield blade configuration. The model was approximately that interference effects between the closely spaced tandem blades might produce propeller efficiency during cruise.

Hamilton Standard points out that the design of the test model is subject to the probability of adequate momentum criteria is sufficient to demonstrate the maximum performance potential of the tandem variable camber propeller. However, on the basis of the existing test results, the company submitted a proposal to the industry which resulted in the Navy development contract. As Fowles, although not funding the project, has expressed interest and is watching the project.

Hamilton Standard has made technical presentations to various aviation companies to stimulate interest in the variable camber propeller. The propeller companies that respond to the propeller research have been especially interested in companies engaged in VTOL design studies.

The VTOL vehicle, with its high static thrust requirement at zero velocity, places severe demands on conventional propellers if an efficient static thrust is to be achieved. Hamilton Standard, in demonstrating the advantages of its variable camber prop, has constructed a typical VTOL vehicle. This lift wing aircraft would have a 30,000 lb gross weight and need 5,000 lb of fuel and a 5,000 lb payload. The aircraft would be 1,000 sq ft at 100 ft static thrust sufficient to provide vertical lift would be 40,000 lb. This means that if four engines delivering 2,500 shp each were employed, a static thrust level of 4 shp/shp would be required.

According to Hamilton Standard figures, one of the variable camber propellers on this hypothetical VTOL aircraft would provide one of the following potential benefits:

• A 60% payload increase from 4,000 to 5,000 lb.

• A 50% range increase from 1,000 to 1,500 mi.

• Alternative benefits of the variable camber prop might be a 20% reduction in propeller diameter or a decrease in engine power.

Hamilton Standard feels that a turbo-prop transport aircraft equipped with the variable camber prop will experience advantages over the turbojet to the Mach 6 in a speed range. Below this speed range, conventional propellers are adequate; above this speed, propellers lose out to jets, jets and turbojets.

### Design Potential

In attempting to demonstrate the design potential of the variable camber propeller on a high speed (Mach 6 to 10) cruise transport, Hamilton Standard notes the following advantages: performance benefits.

• Decrease of 15% in takeoff lift might be gained. The company's hypothetical transport delivered its takeoff thrust at static from 5,000 to 4,750 ft.

• Payload increase of 30%, from 25,000



**TUNNEL** tests measured the effectiveness of the variable camber at approach from zero to Mach 0.6. Engineer checks instrumentation during high camber tests.

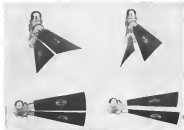
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Columbus, Ohio



**MODEL** propeller blades demonstrate the change in effective number of the variable number propeller. During takeoff the blades form, effectively, three high number airfoils across performance is gained through six point low number blades.

to 26,000 lb., would be achieved over a 2,900-in. stage length.

- Range increase of 20%, from 1,500 to 1,800 ms, with the 20,000-Eb payload could be achieved.

One hindrance to the application of the variable number propeller to high subsonic speed transports is development of high power turbo-prop engines which have taken a back seat to the turbofan. Despite design advantages acceptance of a high speed turbo-prop will require a reversal in the thinking of engine designers many of whom are convinced that the greatest benefit of the turbo-prop is its character as the propeller.

Hydrotreated, along with other new catalysts, is a useful asset of the trend away from propellants. The company, therefore, is convinced that its incandescent demand for its propellants in the VTOL vehicle. As far as transport aircraft go, it can only hope that the inherent advantages of its propellant will stimulate efforts in the subsonic, non-rocket field.

The variable number propeller will be conventional in its instruments, controls. Although the original wind tunnel model employed six blades, eight-blade models will be investigated. One problem may be in fitting the blade roots into the propeller hub. This has limited some metal propeller designs to four blades, but the titanium blade arrangement used was somewhat like the others.

Coarse change of the propeller will be programmed along with pitch change. The pilot will have the usual pump governor control of air constant speed propeller. As the pump speed is brought back to cruise rpm, the effective hub

camber inflexion will be noticed to form on low camber blades.

The takeoff, the first blade out, will maintain constant speed. The propeller will be capable of full feathering and reverse pitch may be provided.



**Mitchell glycol sprayer speeds de-icing job!**

Nicholls's Glycol Sprayer used successfully on several alders he had just sprayed is now available for sale. Working platform extends on hydraulic lift to 15 feet. Tank capacity has been doubled. Heater keeps glycol 20°F temperature due to warmness from White Ice damper.



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### THERMOCOUPLE SWITCHES



Flange  
Cant  
12 in. dia.  
12 in. dia.  
12 in. dia.

Engineered to give years of service in hot work as well as in permanent installations, LEWIS switches have heavy low-voltage contact, positive detent action and sturdy terminals for easy wiring.

The cases are splash proof and dust tight, of close fitting helical Husky black-finished aluminum, making tools are used to turn the stainless steel shaft supporting the rotating brushes.

A companion line of the same construction except that they are fixed with a common terminal ring for these was built concurrently.

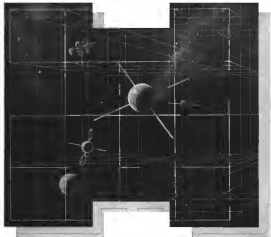
**THE AIRCRAFT DELIVERED  
THE RESULTS.**

Small, sturdy, stainless-steel switch 1 1/4 inches in diameter, 2 3/32 inches total shaft length one hole mounts with 3/4-30 NEMA threaded bushing. Designed especially for monitoring two or more resistance temperature detectors in one instrument, now flying in the modern air.

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**THE LEWIS ENGINEERING CO.**  
Specialists in Temperature Measurement  
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## How to take a satellite



## census

At present rates, man will soon have space cluttered with numerous orbiting objects. These objects are creating a major spaceage problem.

The extra-atmospheric clutter can be resolved, sorted and classified at great range by a new systems concept of satellite intelligence now being developed by Hughes.

The prime sensor is a highly flexible, computer-programmed radar which can chop space into billions of small information cells on thousands of simultaneous beams.

This enormous multiple-beam capacity permits search, track and examination of huge numbers of targets. It also provides the capability for transmitting control information to defense systems or satellite platforms.



These alpha-numeric displays, developed by Hughes Film Lenses Corporation, can simultaneously give hundreds of fast-moving arrays!

Starting with an etching made from an original drawing, the extremely small electrode structure is created by vacuum deposition. The animal matrix of memory cells is used in Hughes diode processing equipment.



These capabilities require a new beam-scanning technique, a major step beyond frequency or phase control of arrays. This kind of advance is typical of the work done by Hughes in radar.

For Hughes was the first to develop three-dimensional radar, the most important advance in the state of the art since radar itself was invented.

This work draws on Hughes' unique experience in virtually every area of advanced electronics, including: space series, microwave communications systems, airborne control systems, air-to-air guided missiles, signal recovery techniques, radar and IIR detection systems, and many others.

The reliability and operational capabilities of these systems have earned them the confidence of users throughout all the free world.

Creating a new world with ELECTRONICS

# HUGHES

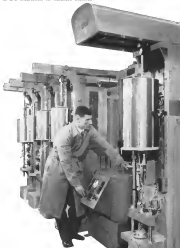
HUGHES AIRCRAFT COMPANY

Calver City, El Segundo, Inglewood, Newport Beach, Malibu, Oxnard, Santa Barbara and Los Angeles, California. Tucson, Arizona

New from SPS...

## 260,000 psi aircraft bolt with high strength-to-weight ratio at temperatures to 900°F

High temperature testing of new EWB 806 bolt  
at SPS Laboratories for Advanced Research



SPS's new EWB 806—a 13-point external wrenching bolt—has what it takes when the going gets hot! Its performance at 900°F exceeds that of a standard MS 20604 series bolt at room temperature. The EWB 806 delivers a tensile strength of 260,000 psi at 900°F. And a designer using this bolt can build in 140% more strength than with use of 180,000 psi room temperature bolts.

What's more, the EWB 806 affords you significant weight savings. Since it provides the same holding power as bolts two to three times as large but of less strength, smaller diameters can be used. Also, because of the reduced bolt hole required, smaller flanges and other structural savings are possible.

Behavioral combination of high strength-to-weight ratio and superb performance at elevated temperatures is careful selection of material: 15% chrome, ultra-high-strength steel alloy, through rolling after heat treatment. Hi B thread form with increased root radius, cold working of lead-in-chamfer fillets.

Additional characteristics of the EWB 806 include:

- Flange strength and tensile strength proportionately high
- High minimum shear strength—144,000 psi
- Performance proved different end-use designs for maximum and extreme resistance at high temperatures
- High stress rupture life
- Available with lightweight noncorrosive coatings—Zn, Zn-Ni, cad plating



For complete technical data on the EWB 806 and the FN 806, write for some Bulletin 3177 and 3171, Standard Process Steel Co. AIRCRAFT MISSILE Division, SPS, Jenkinson B, Menominee • Santa Ana, California

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**POD LOADING** preloading trailer under Canby B-58 Hustler shows the small amount of working space available, which made it necessary to drop considerable automation into loading procedure. Trailer entrance pod for coast mating to booster.

## Units Speed B-58 Pod Ground Handling

By Edwin J. Reiben

At Worth, Tex.—Versatile ground support units for storing, transporting and quickly loading the large, fast-response pod that carries the Canby B-58 Hustler booster with its nuclear strike capability has joined U.S. Air Force evaluation at Carswell AFB here and is now in production.

The B-58A's strike and nuclear capability begins to a large extent upon the speed and ease with which ground crew can handle and load the 57 ft long, 18 in. dia. streamlined pod, particularly in the last stage where they

are operating under the booster, where space is at a premium. Canby's Worth's ground support equipment system was built not only with the need to consider ease of handling and speed, which was solved by having an rear push button control as possible, but also the problem of keeping costs down.

The action they evolved in cooperation with engineers of Space Group, Garland, Tex., which is producing it for USAF, consists of a series of three basic components:

- A storage and workstand unit mounted on 12 adjustable legs, which will be located at a weapon site, prob-

ably some distance from the flight line.

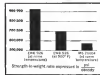
- A transport trailer, to which the pod is transferred and then loaded to the loading site, at or near the flight line.

• A positioning trailer, to which the pod is transferred from the transport trailer, which has the capability of maneuvering the pod under the B-58A for coast mating to the booster.

The three units are provided with earth speed and systems so that each can be connected to the others in the proper sequence and the pod transferred via movable cranes rolling on these rails. Rails on the transport trailer can be adapted vertically or laterally to mate with those on the



**HUSTLER POD** is transferred from storage-workstand unit to positioning trailer, showing how all systems can be hooked up between any of the pod handling system units. Normally, pod would be loaded directly onto transport trailer.



# example... FIBERITE

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many others.

## EXPLORE FIBERITE

Missile engineers will find our  
research helpful in solving  
problems requiring materials  
for special performance. Write  
factory for bulletins on high tem-  
perature insulating materials.



**SAC AIRMAN**, working loading control console, double stop positioning trailer to make feel for alternator for cranking outboard. In first 10 in., positioning trailer provides freedom of movement so that pod will not encounter obstacle in event of asymmetrical contact. In center of trailer's right side is sturdy welded ramp system that can be used for pod loading

storage and positioning units. The cart was the basic means for developing the three-component system. The complete positioning trailer system can be kept in a container using the transport trailer to shuttle to and from the weapons storage site and the positioning trailer reaching there after completing a loading or to pick up another pod and returning to the airplane. Each McDonnell wing of 37½ will have an inventory of 100 storage and work stand units, one transport trailer and one positioning trailer. Transport trailers cost approximately one-third that of a positioning trailer, so the weight in the system averaged here are obvious.

## Designed for Mobility

All units are designed for maximum surface or air transportability. Legs on the storage and workstand unit, for example, are easily extendable and the unit can be towed to a flat-bed trailer or in an airplane while providing enough adequate clearance for the pod feet.

The positioning trailer is the heart of the system. With a 15,000 lb. load capability, it is a low-wheel steerable unit with two-wheel hydraulic drive that provides movement at 2 mph. A four-wheel crane steers the vehicle under the bomber.

Bed of the positioning trailer is operated by an operator system that doubles as a shock sensor while the unit is moving and inhibits bouncing

loads to 2g. Once in position under the bomber, the trailer is locked in position by four jacks that extend to the ground.

From here on, a crew chief uses the pod, using an electrically driven hydraulic system. Guided by three strategically placed ground crewmen equipped with spotlights, he can carefully position the pod by securing controls on a small cabotest control suspended from his neck. Controls permit him to move the pod on wheels forward, backward or in either side, raise jacks and 14-degrees planarization pitch and 14-degrees planarization yaw. Since the B-57A has a critical center of gravity, complete freedom of motion is designed into the pod loading device in the last 14-in. of movement possible so that, should it contact the underside of the airplane asymmetrically, it will not impose a loading that could overstress the pod or the aircraft.

Lock-on is accomplished by two jacks at the rear of the pod prism and one at the front. Large Allen-type wrenches are used to provide final tightening up.

Although the loading procedure sounds complicated, the recent USAF air-vehicle evaluation at Cannon AFB to check its "go-to-war" capability, showed that "gun hands" could load the airplane and remove the positioning trailer in 25 min., including time used in positioning the trailer under the airplane.

## Low Cost Barrier Developed for FAF

Para-Trench is free in adopting an experimental system, according to barrier based on mechanical loading and remote control operation.

FAF units developed in France reportedly meet standards higher than those demanded by NATO. So-called weight 575,000 plus 57,000 for installation and is being utilized at 25 FAF bases.

FAF has been using earlier USAF chain dog breaking units on well on a Swedish pressure loading system. The unit FAF acquires, the French claim, is considerably more flexible to use and changes in install and to operate than those U.S. and Swedish systems.

French barrier system is designed to arrest aircraft either taking off or landing.

Breaking force can be set at one of three values. At the lowest value the equipment stops a 10 metric ton aircraft touching at 107 kt. surface 510 ft. after hitting the barrier. At its highest value the equipment stops the same aircraft hitting the barrier at 181 kt. For heavier aircraft up to 40 metric tons, top impact speeds are lower.

For example, maximum breaking equipment handles 30 metric ton aircraft at 107 kt.

Breaking force is progressive and deceleration felt by the pilot is about less than 2g. During the recent NATO demonstration at Inver FCF test center, a Dassault Mirage IV, weighing seven tons, was stopped through the barrier at 138 kt. Aircraft which itself had activated the system, came to a stop within 400 ft. System was ready to operate again within 10 min.

Weighting seven tons, FAF system consists of three main elements:

- Two deflation bars down located on each side of the ocean area.
- Nylon barriers made up of 20 nets of 10 nylon strips which form a barrier 45 meters wide (147 ft.) and four meters high (13 ft.).
- "Electric eye" remote control units which straddle the runway some 400 meters (1,312 ft.) from the nylon barrier.

Behind each bar is a cable storage unit. The cable is wound 11 times around the cable system, made up of steel and bronze disks, and then run out to the nylon barrier. The cable is attached to the barrier via a nylon shock absorber to handle shock at the release.

The system works in the following manner:

An aircraft passing between two photoelectric pairs located one behind the other on each side of the runway



**FAF** barrier system developed in France to force a change in landing position, barrier is activated when aircraft traps remote control units. Forces are less than 2g.



**BARRIER** is shown in deflated position (sheet) after being hit by aircraft. Nylon damage to forward tail finning.



determines whether the burner is actuated. The burner is reset if the air-fuel speed is calculated as too fast to stop the flame with its own losses or too slow for normal takeoff. These speed values can be varied, but the circuit speed actuates the burner. The latter, however, also can be controlled from the control tower or from a control board situated near the starting equipment.

When the rocket hits the burner, the burner draws start operating progressively. Blocking of valves is impossible, because, if one valve is working more than the other, there is automatic compensation. Then the air

craft is held enough on a straight line, no matter where it hits the burner at its angle of impact.

Twelve engineers say that even in one of high stress, better heating is required.

Brake data shows little wear or fatigue effects even after repeated use.

#### Tower Control

Airfield features of the system is that the three values of heating force can be selected from the control tower. Thus if a heavier strength, not typical of an airfield's normal traffic, has to be handled, control tower operators merely increase the heating power by push-but-

ton downward. The tower is ready for the heavier load within 5 sec. after the command signal.

Once used, the nylon net is refilled and a new cable from the storage unit is threaded through the hole and pulled off while can be fitted again as the cable moves if it isn't defective. Designers recommended the 3 in. cable not be used more than twice, except when only 120 to 150 ft. have been pulled off. Used cable in this case is usually cut off.

Burner is ready for use again within 30 min. from emergency operation. This time is shortened to 10 min. if a standard refuel net is kept ready. Brake data requires no regulation after use.

Burner was designed to F41 speed criteria by three French companies headed up by La Societe des Applications Radio, Grenoble. French companies hope to market their burner design throughout the NATO region.

#### PRODUCTION BRIEFING

Weather sounding rocket, capable of taking a 6th payload to 120,000 ft. and designed to be fired from a 5-in. gun (for shipboard use) or from an aircraft shipping container, has been designed by Solid Propellant Operations, Reaction Division, North American Aviation, McGrath, Tex. American-made rocket propellant, intended into a single star-shaped grain, provides 660 lb. of thrust for approximately 15 sec. in the 105-in.-long 4-in.-dia. vehicle.

Calfax Radio will investigate problems involved in recommending with increased subloading laser probe vehicle both during flight and after landing under contract awarded by McDonnell Aircraft Co. McDonnell is one of four companies conducting five-month study of an extraterrestrial laser probe under contract with National Aeronautics and Space Administration's Jet Propulsion Laboratory (JPL July 16, p. 37).

Nuclear Corp. has a \$998,000 Air Force contract for research in low drag boundary layer control.

General Electric Co. has delivered the first production model Polaris fire control transducer to the Navy. Transducer will be installed in Polaris submarines to help crews maintain proficiency.

Cheney Aircraft Corp. has a \$1.5 million contract to install a new color frame guidance system on Republic F-105 to supplement the aircraft's color conventional guidance system.

Convair B-58 entered Category 1 of its operational and evaluation program.

See Elsewhere's recent products, Books 708-709 WESCON, Los Angeles Santa Anita August 23-25



## HETEROGISTICS

If it's a non-Aristotelian world, few of us can take our syllogistics straight. Most of us choose them with a pang each of empirical data and educated hunch. Let's call it **Heterogistics Example**. **1** Premise: Giannini's systems capability is based on unsurpassed depth of component experience in **Air Data Instruments, Inertial Instruments, Servo Components**. **2** Premise: From that depth comes a standard of performance best appreciated by those who already depend on Giannini for better measurement and control, everywhere on earth and above it. **3** Add: Long experience in anticipating and solving complex systems problems, continuing research into changing requirements for component performance. **4** Conclusion: Giannini is a Home to Plan With.



**NEW MILLER CONSTANT POTENTIAL B-C WELDER CP-3-VS**

3-reg. potential B-C welder on aluminum, magnesium, titanium and carbon steel steels down to 230° and the welder built with the New Miller Constant Potential, CP-0-02, transformer design and voltage adjustment used during the entire arc. The welder means that the operator is able to "tune in" the desired settings. There's no burn through, there's no spatter. Actually, a new performance high in low voltage welding is accomplished with the introduction of this welder with its lowest range of from 30V range at 20 to 25 amps at air — complete specifications, as well as recommendations for cost effective specific problems, will be sent promptly upon request.

**miller** ELECTRIC MANUFACTURING CO., INC., APPLETON, WISCONSIN  
 Distributed in Canada by Canadian Light & Co., Ltd., Montreal

THESE AND DOZENS OF OTHER MEASUREMENT AND CONTROL SUBSYSTEMS IN DAILY OPERATION HAVE BUILT THE GIANNINI REPUTATION FOR FAST, KNOWLEDGEABLE DEVELOPMENT OF **SYSTEMS**



#### A "GUN BARREL" HALF-A-MILE LONG

The need was for a new inertial platform. Small and light enough for tactical missiles. Yet able to keep the boost trajectory gun-barrel-straight and the impact dispersion small. • First to answer the need was Giannini

with a revolutionary new inertial system you can hold in your hand... and which costs one tenth as much as full guidance. • This startling development is made possible by Giannini's diversified capabilities and is based on two exclusive Giannini components. A miniature free gyro. And an ultra-miniaturized accelerometer which senses very small lateral accelerations, yet ignores the high g's of boost thrust.

#### PITCH TRIM COMPENSATOR FOR DC-8 JETLINER

Problem... As aircraft probed into the transonic speed range, aerodynamic trim characteristics change. An adjustable Mach computer and power package were needed to deliver corrective force at the pilot's control column. • Solution... Giannini delivered a small, highly accurate servocomputer-controller with a pulse-modulated output. • Douglas now specifies the Giannini Trim Compensator system as standard equipment on every DC-8 delivered.



#### THREE-AXIS RATE GYRO SYSTEM FOR TITAN

Flight stabilization of the Martin Titan required a package gyro system—to provide the highest degree of performance stability, accuracy and reliability under severe environmental conditions. • Giannini met the requirement by designing a three-axis gyro system for flight control and for telemetering pitch, roll, and yaw rates. Two of these subsystems are used in every Titan.



THIS MAKES GOOD SENSE: HE WHO KNOWS MOST ABOUT ALL THE PARTS CAN BEST PUT THEM TOGETHER INTO A WHOLE THAT WORKS. ONLY GIANNINI HAS PROVEN EXPERIENCE IN SUPPLYING ALL OF THESE **COMPONENTS**



#### AIR DATA INSTRUMENTS

Giannini Air Data Instruments offer you the widest choice in the industry. For years they have set aviation standards and served as building blocks for control and flight test subsystems. The Air Data line includes: **Absolute, Differential and Gage Pressure Transducers — Servoed Pressure and Pressure Ratio Instruments — Probe and Vane Sensors.** All give evidence of a progressive engineering philosophy that emphasizes originality, simplicity, flexibility.

#### SERVO COMPONENTS

The Giannini line of precision potentiometers and special electromechanical devices meet standard and special needs for all types of high-performance servo systems. Included are: **Precision Potentiometers.** Linear and non-linear, single-turn and multi-turn rotary. Low-torque models. Rectilinear units with or without spring loading. Unique **Spiralpar®** with infinite resolution from a wire-wound element. **Stopping Motors — Segmented Torquers — Milliwatt Motors.** More reasons why Giannini serves aerospace engineering/management fast and well... In design, liaison, production, field service.

#### INERTIAL INSTRUMENTS

Success in the design and production of inertial instruments puts a premium on the maker's experience. For more than a decade, Giannini has been developing outstanding inertial components for the nation's missiles and spacecraft. The line includes: **Gyros, Rate and Free.** High-level AC or DC output. AC and DC electrically powered rotors. Pyrotechnic rotors. High reliability in presence of unfriendly environments. **Accelerometers, Linear and Statistical.** Environments: seismic, high-temperature, intense nuclear radiation. **Integrating Acceleration Switches.** Used by virtually all major prime contractors in scores of world-wide projects.







CLOSER THAN YOU THINK



Yes...The world has shrunk and now the Universe is shrinking, due to man's restless thirst for knowledge. California General...An explorer of frontiers. For scientists and rockets...is playing a significant role in helping to bring the bodies of outer space closer to us.

One of California General's products... exhaust nozzles for rocket engines... is an essential part of the vehicle which will eventually carry man into space...meeting up closer neighbors to the moon and planets.

CALIFORNIA GENERAL, INC.  
Foot of F Street, Chula Vista, Calif.



Tenno Overhead & Armaments, Greenville, S.C., is the manufacturer of the Air Force C-117 will arrive at Caswell Air Force Base, California, in 1961.

Vito Corp. of America's Viro Laboratories Division received a \$5 million USU contract for operation and maintenance of the Egan Golf Test Range through June, 1961. Vito designed and had the range system last year.

Slovely Aircraft Division of United Aircraft Corp. will build 30 B-17 helicopters, including installation of electronic instrumentation equipment, under a \$1,415,394 contract from Army Transportation Materiel Command.

Aerospace Machine and Foundry Co. will study methods of improving, standardizing and reducing number of Defense technical manuals, the release of which has increased four times since 1959.

Ryan Electronics Division of Ryan Aeronautical Co. will build AN/APN-122(V) Doppler navigation sets for installation in Lockheed P-1V, ASW aircraft under order exceeding \$250,000.

Norel has awarded contracts for 528 million to Northrop Corp. for design, development and production of electronic components for Polaris fleet ballistic missile. Contracts include automatic electronic systems (AW-100, p. 36), gyroscopes, Type 11 periscopes and electronic systems.

American Bridge Division of U.S. Steel has started contract of steelwork for construction of a new United Air Force hangar for jet transports at Chicago's O'Hare International Airport. Hangar will be single level, conventional-type building with a 133-ft. clear.

Space Power Operations to design and build systems to power equipment in space vehicles has been formed by General Electric's High Propulsion Laboratories Department at Cincinnati, Ohio. A. Zyglis leads the new unit, which now is working on nuclear turbopump systems using high temperature liquid metal as the working fluid.

Kellett Aircraft Corp., Willow Grove, Pa., has been awarded a new contract by the U.S. Navy Personnel Office for the manufacture of hydraulic hand trucks. The four-wheeled, portable trucks are towable-type type, with a 4,000 lb. capacity, and are designated Model N461. The trucks will be used in maintenance support activities and for handling parts, supplies, weapons and other items in operational service.

## Army Schedules 29 Test Flights For Fairchild Surveillance Drone

Washington—Army has scheduled a test program of 29 flights for the Fairchild long-range surveillance drone during Fiscal 1961 in a development plan aimed at making the drone to overcome troops by mid 1964. Fairchild Tropic and Aermacchi Corp. AN/USD-5 will be first of three drone types designed specifically to support tactical field missile operations. Army has ordered 15 drones for the test program under a \$45.6 million firm-fixed development contract awarded in June 1957.

Rhone Manufacturing Co.'s short range AN/USD-2 is scheduled for use in driver and battle groups soon after the Fairchild drone becomes available. Republic Aviation Corp.'s medium range AN/USD-4, to go to corps strength units, is in the early development phase.

Long-range SD-5, to be used to screen and zero groups, has a range of approximately 1,000 mi. and flies at high subsonic speed. It will carry 150 lb. of reconnaissance, which includes will be photo, infrared and radar sensors. Army Signal Corps is studying television, electro-optical and radiation sensors for future installation.

The 5,100 lb. vehicle is built around a piston reinforced with glass fiber. Method of forming plastic structure under high pressure was pioneered by Fairchild in the cancelled Goats de coy missile program. The USD-5 is 50 ft. long and 5 ft. high. Delta wing has a span of 24 ft.

The drone is launched from a zero-length rail. Solid fuel Propellant Air-to-air rocket burns three seconds, then drops out. Booster engine is a Pratt & Whitney R40 turbojet. Booster has a thrust of 50,000 lb. and the drone is controlled in the boost phase with a piston.

### Internal Navigation

Each vehicle is preprogrammed, using an internal navigation system for guidance. An autopilot is used for stabilization. As the drone approaches the recovery area, engine fuel is jettisoned and the engine flames out.

Two recovery parachutes then deploy, and the landing shock is absorbed by air bags, one under the nose and one under each wing.

During flight, engine transmits real-time data to a command post acquisition boat. System also contains on-board data type which can be altered and recovered after recovery.

First powered drone flight was made May 14, and second June 24, both at

Yuma Drone Test Station. Initial flight lasted 70 min., and the second lasted more than two hours. Powered runs were preceded by three dummy drone launches to test the boost system and the two Boeing B-72 drops from 1,900 ft. to exercise the parachute system.

Pratt & Whitney R40 powerplant is the initial version of the FT12, which enters this month into test in Yuma. Aviation Agency, under contract to the Army (AW-100, p. 36), the 410 lb. J40 used at 5,000 ft. altitude thrust, also will power the Republic SD-4 drone.

Army has awarded reconnaissance aircraft will continue in combat service later, but the first tactical drone launched in active warfare units announced drone recovery.

### All Weather Capability

Col. George M. Wertz, deputy commander of the Army Central Surveillance Agency, points out that reconnaissance vehicles must provide day and night accuracy, without regard to weather conditions. He said drones can be developed with range and performance characteristics giving reasonable

chance of survival without requirement for altitude.

For child in building vehicles and assembling ground support equipment at its El Segundo, Calif., plant. Systems manager for electronics guidance and control is Fairchild's Aeronautics Division.

Major subcontractors in addition to Pratt & Whitney are Sperry Remitt, Sonnet, Inc., for landing systems; Farn Instruments, Inc., under Fairchild Contract and Instrument Corp. and Omega Aerial Industries Inc., under National Electronic Products Co., for landing systems; Minneapolis-Honeywell Regulator Co., for flight guidance; Edgar Process Division of Borden Corp., autopilot CDS Laboratories Division of Columbia Broadcasting System Inc., data display; Philco Corp., computers; and International Telephone and Telegraph Laboratories, guidance.

The 29 flight test program scheduled for the remainder of this fiscal year will include use of 15 test vehicles. Fairchild estimates each production drone will cost \$140,000-\$160,000 and each data acquisition ground handling system will cost about \$2 million.

Ground support equipment will be used for more than one drone, and Fairchild will fabricate the vehicles so that parts most divergent can be replaced quickly in the launch area.



Republic Tests Swallow Chute System on Sled

Republic Aviation missile engineers make final adjustments to the sled used prior to removing tests on the main parachute system of Republic's Army SD-4 Sentinel reconnaissance drone for the Signal Corps. Sled pushes the system down sled at about 280-300 mph to check out mechanism which makes the Sentinel recoverable. Sled, a drift wing configuration, is powered by a Pratt & Whitney R40 turbojet engine (AW-100, p. 36) and will use infrared detectors and radar to spot enemy activities.

# IN PRODUCTION AND IN USE

## BELL AVIONICS

## MINIATURE ACCELEROMETER

☆☆☆☆☆☆☆☆



It's the **LIGHTEST** and **SMALLEST** with **HIGHEST PERFORMANCE** of any Accelerometer available in quantity today.

The **BELL Model III B Accelerometer\*** is an electrically constrained, linear, inverted pendulum type with a D-C force and spring suspension. This precision instrument has been thoroughly tested and evaluated by government laboratories.

The superiority of Bell Accelerometers has been proved in many competitions. They have already been selected for such programs as:

### SERGEANT—AGENA (including SAMOS and MIDAS) RANGER—SKY BOLT

\* A new Model V A will shortly be available with the same performance but a substantial reduction in both weight and size.



**MODEL III B**  
**AVAILABLE WITH ANALOGUE**  
**OR DIGITAL CIRCUITRY**  
Range:  $\pm 43g$   
Weight: 0.7 pounds

OTHER BELL AVIONICS PRODUCTS also designed and developed by Bell's Instrument Systems Laboratory under the direction of Dr. Helmut Schlier include:  
Digital Velocity Meters  
Inertial Guidance Platforms  
Gyroscopes  
Gravity Gradient Meters

Direct inquiries to: Instrument Laboratory • 4515 Superior Ave. • Cleveland 3, Ohio



**BELL AEROSYSTEMS COMPANY**  
a Bell Aircraft Corporation **BUFFALO 6, N. Y.**

## NEW AVIATION PRODUCTS

### Helicopter Power Unit

Electrical power unit provides d.c. current to start helicopters aboard Navy ships.

Model B541-406K power supply is rated 20 to 75 v.d.c., 500 amp. with permissible overload to 900 amp. The power supply unit contains magnetic amplifier and silicon diode rectifying elements.

Circle Electric Corp., 1410 W. 67th St., Los Angeles 49, Calif.

### Radar Safety Plate

Cathode ray tube safety plate, designed for FVA radar control console, reduces eye fatigue without creating target distortion.

The plate incorporates a transparent conductive coating which is grounded to eliminate lateral capacitance effect. A neutral density filter absorbs ultraviolet and reduces the contrast ratio, preventing the scope to be monitored in lighted control rooms. The safety plate may be supplied with or without the conductive coating and with an desired color characteristic.

Marka Polaron Corp., 155-16 10th Ave., Whitestone 37, N. Y.

### Solid Rocket Wire

Steel wire is designed to form casings for solid rocket nozzles. The wire,



which is combined with plastics to form the high pressure container, has a tensile strength of 775,000 psi.

Norfolk-Standard Co., Niles, Mich.

### Polaris Power Unit

Power unit drives the main hydraulic system of the first and second stages of the Polaris missile. The package has a guaranteed standby of five years.

The APD operates on 28 v.d.c. between at 11,000 to 20,000 rpm. The pump system operates on MIL-5606 fluid with a maximum operating temperature of 212°F. Pump operating range is designed to meet varying load



### Maintenance Trailers Support Republic F-105

An incompressible trailer will permit anywhere land maintenance on Republic F-105 aircraft at forward air strips. The trailers are designed for one of five operations: maintenance, electrical repair, painting, welding and pressure hydraulic work. Self contained power units provide 120 v., 60 cps. a.c. and two of the trailers supply air at 300 psi. Republic Aviation designed the F-105 ground support units.

requirements of first and second stages. An angled silicone coating acts during launch to protect lining to move in a heat sink, thus protecting the APD from high temperature.



Victor, Inc., division of Spryco Road Corp., Detroit 32, Mich.

### Bosket Igniter Shut-off

Pneumatic actuator controls the flow of ST-1 fuel to rocket motor igniter.

Hydram gas is used in actuator as a fuel ball valve which opens at speeds of 0.018 to 0.15 sec. and closes at 0.060 to 0.100 sec. Operating pressure of the crimping valve is 746 psi; ambient temperature range is from -52 to +160°F; pressure drop across valve

is approximately 14 in. of water at 400 psia flow.  
Kashlin Aircraft Products Co., 409 Lee St., Dayton, Ohio.

### EDM Cooling System

Liquid cooling system for airborne electronic components makes use of a hydraulic coolant pack with

continuous flow resistor assembly. The cooling system components are:



be mounted together (as shown) in separate units. The cooling pack, weighing 17 lb and measuring 5 1/2 x 7 x 3 1/2 in., has a capacity of 2,000 watts. Control unit is provided in contact at a maximum temperature of 160F delivered at 1 gpm and 55 psi discharge pressure. Power requirements: 315-205 v, 400 cps 3 phase, and 28 v d.c. for control purposes.

Eastern Industries, Inc., 100 St. Charles, Conn.

#### Hel Gas Valve

Pressure relief valve relieves excess pressure in solid-propellant gas generators. Original application was for an altitude control system for a rocket vehicle.

The valve, model PRV-29, can be set at any cracking pressure between 1,250 and 1,650 psi, with opening line ten



percent to 2,000". The unit is qualified to MIL-E-87133. Musetta Valve Corp., Roseton, N. J.

#### High Temperature Lookout

Self-heating unit is rated at 145,000 psi tensile strength with a tensile rupture rating of 1,000F. The lightweight unit is intended for high performance aircraft and missile requirements.

The FN 1014 unit exceeds minimum NAS 1290C requirements and has a reduced-height hexagonal windwing area for minimum drag. The unit is rated for looking ranges on the basis of 15 separate sealed applications at an ultimate bolt stress of 75,000 psi, rather than on basis of 15 unsealed applications.

Standard Pressed Steel Co., Jenkintown, Pa.

#### High Speed Switch

Lightweight, high speed Sae 5 rotor switch for use in aircraft or missile has been developed by separator or switch circuitry as a function of time or of shaft position.

High current loads can be handled when the switch is used in conjunction with sensitive relays or solid state switching techniques according to the manufacturer.

Ruskon Division of General Precision, Inc., 1150 McBride Ave., Little Falls, N. J.

## Unit Provides Night Landing Simulation

Washington—Flight simulator attachment, expected to reduce the costs of training pilots to shift from instrument to visual flight conditions on the landing approach area, has been developed by Barton Rogers, Inc.

Scalable Landing Attachment for Night Training (SLANT) provides a realistic visual simulation of night landing conditions from the point of touchdown through touchdown to the end of landing roll. SLANT has been demonstrated to the Navy and Air Force.

Simplicity and cost maintenance are claimed for SLANT by the company, which also claims that real projection techniques used in SLANT plus its compact size, will add significant gas phase and maintenance savings when compared with the costs of more complex systems using closed circuit television systems with simulators.

Heart of the system is a self-contained one projection unit which is fitted to the front of the cockpit of a flight simulator so that a viewing screen, which forms one side of the projection box, is visible to the student pilot through the simulator windshield.

Different approach and runway light



SLANT projection unit is easily mounted and disconnected to provide varying degrees of runway approach angles. Special film looks through beam area, at the right of unit, for viewing projection three feet forward. Dark weights above are counterbalanced. Scene drive motor at the top of the module governs aircraft eye angle while vehicle-mounted servo on the eye governs wing action. Switches positioned on base mounting of prototype model is manually operated to peak eye scene from simulator screen. Later production models will accomplish this task automatically.

## New GV-1 tanker delivers jet fuel for the United States Marines

Now Marine Corps jets can refuel at 300 knots—over 25,000 feet high. The new GV-1, Lockheed Hercules tanker pumps jet fuel probe-and-dropee style at 300 GPM. There's a hose-pod mounted outboard of the engines on each wing, so the big tanker can handle customers two at a time. The GV-1 can receive

with jet fighters at 1000 miles from its home base to off load 25,000 pounds of fuel.

The first of the GV-1s will go on active duty this year.

**LOCKHEED**  
GEORGIA DIVISION HARRISBURG, GEORGIA





#### KNOW YOUR ALLOY STEELS . . .

This is one of a series of advertisements dealing with steel facts about alloy steels. Through much of the information given is elementary, yet because it will be of interest to many in this field, including even of broad engineering value, we try to find it useful to review fundamentals from time to time.

## Annealing: Its Uses with Alloy Steels

Broadly speaking, the primary purpose of annealing is to soften steel and make it more workable. Annealing, as applied to alloy steels, may be defined as a process that heats above, and furnace-cools through, the critical range at a controlled, specified rate of speed, or that heats to a point within, and furnace-cools to a point below, the critical range. In either case, the choice depends upon the structure and maximum hardness desired.

The first method produces a lamellar pearlitic structure, while the second creates a spheroidal condition. These will be discussed separately in the following paragraphs:

(1) *Lamellar pearlitic structure.* It should be mentioned at once that this structure can be obtained both as described above and by a modified method known as isothermal annealing. In the isothermal process, the steel is heated above the critical temperature (mentioned), then transformed at a predetermined temperature, which depends upon the analysis. This operation requires two furnaces or salt baths—one for austenitizing, one for transformation.

Lamellar pearlitic structures are generally associated with machinability in carbon ranges from 0.30 to 0.60 pct, provided the hardness does not exceed the optimum maximum

Brinell numeral. This is especially true where critical tooling is involved. It is a very versatile structure, as it gives best results in such operations as broaching, tapping, threading, deep drilling, boring, milling, and tooling as applied on angle- and multiple-spindle bar automatic machines.

(2) *Spheroidal structure.* There are two general fields of use for this type of structure when alloy steels are employed. In the low and medium carbon ranges, spheroidization is necessary for cold-shaping operations, such as heading, extruding, drawing. In the higher carbon ranges (over 0.60 pct), it is mandatory where machining is involved, because it tends to lower the hardness of the steel.

If you want more details about these and other uses of annealing, and the results to be expected, by all means consult with our technical staff. And when you need alloy steels, Bethlehem can offer the full range of APM standard grades, as well as special-analysis steels and all carbon grades.

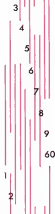
This series of alloy steel advertisements is now available as a compact booklet, "Quick Facts about Alloy Steels." If you would like a free copy, please address your request to Publications Department, Bethlehem Steel Company, Bethlehem, Pa.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.  
Export Division, Bethlehem Steel Export Corporation

**BETHLEHEM STEEL**



verity  
events  
permanently  
in  
milliseconds



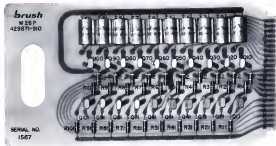
Brush Operations Monitors' response to signals is virtually instantaneous—less than 4 milliseconds. Multiple high-speed events are clearly defined from start to stop, on a concrete time base—and at rates up to 500 per second. Portable 30 channel or rack-mounting 300 channel models record sharp reproducible traces with fixed-style or electric writing that provides the utmost in reliability. "Built-in" transistor switching to eliminate relay is optional. No direct wiring recording system can match the capabilities of Brush Operations Monitors for industrial and military analysis and control. Write for complete specifications and application data.

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compact  
transistor switching  
for  
millisecond  
monitoring



The new Brush Trans-Switcher eliminates relays—greatly simplifies your problems of operations monitoring. Designed to take full advantage of the fast response and high resolution of Brush Operations Monitors, this compact, solid-state switching unit accepts up to 100 different "on-off" signals in a broad range of pulse shapes and amplitudes. Interchangeable, plug-in decode boards are designed to accept different voltage ranges and modes of operation. Avoid the "black box" approach—specify the standard Brush Trans-Switcher for the ultimate in precise, reliable monitoring. Write for complete details.

**brush** INSTRUMENTS  
A DIVISION OF  
37TH AND PERRIN STS. CLEVELAND 14, OHIO



Gaseous propellant gun is wrapped with 907W-100 tape, each turn overlapping half the tape width to provide double thickness. See trimming to final size (right) in close to gross of bearing, and to provide smooth finish and good adhesion of insulator.

## Rocketdyne Builds Tartar, Terrier Gas Generators



Production of solid propellant gas generators to provide rapid activation of Tartar and Terrier missile electrical and hydraulic systems will be covered out at McGraw-Hill, Inc., by North American Aviation's Rocketdyne Solid Propellant Division under a Navy contract. Completed gas generator (top photo) unit is at left; one is shown below RD5-170 propellant that known on data manual depicts no component parts of the gas generator system. These gas generators incorporate a novel burst plate of hot burning nitropropellant conduct that convert the initial energy of the missile motor's tubular and a seal bearing main stage propellant adaptation of common motor propellant used in the M44A1 ATGW.



Full-size burst plate, Rocketdyne FF-54 shows gas-impregnated cloth protect gas generator case from heat of burning propellant, in ready state with gas tape, holding one outside transporter to maximum of 200° although the RD5-170 propellant burns at approximately 2,100°. End plate (right) is ready to be locked into place with gas tape already located in case.





The Explanation of Space-Balant  
 Johnson—the Meridian Co., 60 Fifth  
 Ave., N.Y. 11, N.Y. \$1.50, 160 pp.  
 Presents the Van Allen radiation belts,  
 the Argus experiment, photos and sci-  
 entific facts in the solar system, rocket  
 sciences and other categories.  
 Advances in Cryogenic Engineering—  
 K. D. Timmerhaus—Plenum Press, Inc.,  
 227 W. 17 Street, N.Y. 17, N.Y. \$11.95,  
 184 pp. Proceedings of the  
 Fifth National Conference, held at the  
 University of Colorado at Boulder,  
 Sept. 2-4, 1959. Volume V.  
 Intended Bulletin—Helen L. Buck-  
 ert—McGraw-Hill Book Co., Inc.,

120 W. 42nd St., New York 36, N.Y.  
 \$10.00, 272 pp. A survey of institu-  
 tions, practical examples, and clear  
 discussions are given in explaining the  
 versatility and inherent possibilities of  
 effort.  
 Handbook of Cosmonautics—U.S. Air  
 Force—the Meridian Co., 60 Fifth  
 Ave., New York, N.Y. \$15.00, 84 x 114  
 Revised Edition. Topics presented are:  
 the cosmo's atmosphere, geopotential,  
 cosmic radiation, meteors and nearby  
 objects. Sets of nine scientific papers  
 by the U.S. Air Force prepared for  
 the book.  
 Advances in the Astronautical Sciences

—Plenum Press, Inc., 227 W. 17 St.,  
 New York 37, N.Y. \$8.00, 356 pp.  
 The Proceedings of the 2nd West  
 on National Meeting of the American  
 Astronautical Society.  
 Resolutions—Transpacific—by Earl  
 N. Rosenbush—Graduate School of  
 Business, Stanford University, Stanford,  
 Calif. \$4.75, 151 pp. Based on  
 speeches given at the 1959 Transpacific  
 Management Program at Stanford  
 University and the 1959 annual conven-  
 tion of the National Defense Transpacific  
 Association.  
 Theory of Wing Sections—by H. Abbott  
 and Albert E. Von Karman—Doyle  
 Publications, Inc., 158 Varad Street,  
 New York 34, N.Y. \$2.95,  
 695 pp. paperbound. Concise presenta-  
 tion of the most important and useful  
 results of research on the aerodynamics  
 of long sections of subsonic speeds.  
 A. Theoria on Cosmology and Re-  
 turned Motion—Andrew G. Doyle  
 Publications, Inc., 158 Varad St., N.Y.  
 34, N.Y. \$2.75, 530 pp. paperbound.  
 A systematic discussion of cosmological  
 action and relational motion.  
 Theory of Flight—by Richard C. von Sigmund  
 —Doyle Publications, Inc., 158 Varad  
 Street, N.Y. 34, N.Y. \$2.85, 619 pp.  
 paperbound. Account of fundamental  
 fluid dynamics.  
 Basics of Cosmonautics—by Carl Mich-  
 son—John P. Rife Publications Inc.,  
 116 W. 34 St., New York 18, N.Y. Vol. 1,  
 132 pp., Vol. 2—130 pp. \$3.10 each  
 as paperbound. Basic explanations of the  
 principles of science of cosmonautics.  
 Theory of Thermal Stresses—James A.  
 Bailey and Jerome H. Woinow—John  
 Wiley & Sons, Inc., 440 Fourth Avenue,  
 New York 16, N.Y. \$15.50, 586 pp.  
 Account of theoretical techniques for  
 determination of stresses produced in a  
 solid object when it is subjected to spec-  
 ialized loading conditions.  
 Fundamentals of Rocket Propulsion—  
 Raymond E. Wied, Jr. and Robert F.  
 Strauss—Reinhold Publishing Corp.,

430 Park Avenue, New York 32, N.Y.,  
 \$5.50, 135 pp. Illustrations and ex-  
 planations of the rocket engine.

Aerion in the Modern World—James  
 V. Bernard—E. P. Dutton & Co., Inc.,  
 300 Fourth Avenue, New York 10,  
 N.Y. \$5.95, 312 pp. History of aro-  
 nos plan results and space vehicles.  
 Photos and line drawings are provided.

Nuclear Flight—L. Carl Kenneth F.  
 Gault—USAF—Duff, Sloan & Patten,  
 Inc., 124 E. 30th St., New York 16,  
 N.Y. \$4.00, 214 pp. A survey of pro-  
 jects being made by the USAF toward  
 nuclear flight. Including a glossary of  
 terms, guide to symbols, and notes on  
 the contributors.

Dynamics of Guiding Gun—Al  
 Robert Cornish & John B. Fenn-  
 Northeastern University, Boston,  
 Boston, MA—The proceedings of the Third  
 Annual Gun Dynamics Symposium pre-  
 sented by the American Rocket Society  
 and Northeastern University.

Digital Computer and Control Engi-  
 neering—Robert Sheres Lefsky—Mc-  
 Graw-Hill Book Co., 120 W. 42nd  
 Street, New York 36, N.Y. \$14.50,  
 83 pp. This book, which is divided  
 into two parts, covers the field from a  
 detailed engineering viewpoint.

Wend on My Wings—Duffy Kaszab-  
 Doubleday & Co., 571 Madison Ave.,  
 New York, N.Y. \$3.95, 217 pp. An  
 account of the author's experience on  
 his mastery of flight from his first solo  
 to a 25 hr. trip across the Atlantic in a  
 light plane.

Ghost Ship of the Pole—Wilbur Cross-  
 William Sloane Associates, Inc., 475  
 Park Ave. South, New York 36, N.Y.,  
 \$5.95, 304 pp. Story of the Hebe,  
 the sloop that crashed into the Arctic  
 Ocean on May 25, 1920, her captain,  
 Umberto Nobile and her crew.

The Years of the War Birds—Arth  
 Winkhouse—Doubleday & Co. Inc.,  
 571 Madison Ave., New York, N.Y.,  
 \$4.95, 354 pp. Account of the pilots  
 and planes of World War II.

Card Air Regulations for Mechanics—  
 Aero Publications, Inc., 2162 Sunset  
 Blvd., Los Angeles 26, Calif. \$4.75,  
 152 pp. Applicable to mechanics work-  
 ing on either the structural or engine  
 sections of aircraft.

Flights of Fancy—Frank K. Smith—Rin-  
 don House, Inc., 457 Madison Ave.,  
 New York 22, N.Y. \$5.95, 247 pp.  
 The author relates his and his family's  
 adventures on "Fancy," a Piper Com-  
 monche.

## PROBLEMATIC RECREATIONS 27



A man stood for a week under the branch of his watch were oriented  
 between three and four o'clock. When he finished, the hands  
 were again oriented between five and six o'clock. What was the  
 secret when he started, and how long did he wait?

—School Science and Mathematics

We counted up the other day and found that Trid Transducer  
 Corporation, a Division of Larson Industries makes 962 different  
 instruments. RQAP, the Signal Corps quality control plan, deter-  
 mines the environment in which the transducers are made.

ANSWER TO LAST WEEK'S PROBLEM: He didn't add up with two  
 equal squares, their sides are 31" and 49".

**LITTON INDUSTRIES**  
 Beverly Hills, California

## NEW HIGH PERFORMANCE



KEARFOOT's new B Series E high performance serv-  
 motor generator features high output  
 and extremely low self-heating. The signal in-  
 duction ratio at 100:1 and linearity of 0.2% make the application  
 of this motor generator to lightweight interceptor missiles  
 most desirable. Sensible steel construction and thermal stability  
 assure its reliability and long life in the most severe environments.

**KEARFOOT DIVISION**  
 6700 Park Ave., Jersey



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Buckeye

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 tion refueling equipment.

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- CONVERGING REFUELING NOZZLES
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 HYDRAUTIC VALVES
- HYDRAUTIC GAUGES
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 land and New York Refueling  
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 CITY \_\_\_\_\_ STATE \_\_\_\_\_

## Tu-114 Records Certified

McDonnell-Peterson Aeromarine In-  
 ternational has certified 24 world speed  
 records set by a Russian four-engine  
 Tu-114 during three flights last March  
 and April (AWE, Apr. 35, p. 41).

The marks include 3,000, 2,000 and  
 5,000 lbs. closed-circuit flights each of  
 which set eight records for speed with  
 loads of 0, 1, 2, 5, 10, 45, 75 and 25  
 metric tons. As certified by FAA the  
 Tu-114s flew for 1,800 hrs. on 723.19  
 kph (544.15 mph) for 2,000 lbs. at  
 657.277 kph (412.809 mph) and for  
 the 5,000 lbs. at 677.212 kph  
 (420.749 mph).

Two of the records were formerly held  
 by the United States.

Another of a series of Alenco  
profiles products by ALINCO

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Model 344  
Tension  
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Load Cells

- ACCURACY  $\pm 0.1\%$
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ALINCO is now producing  
a new tension/compression  
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is assured by using two and  
more integrals. At stresses of  
30,000 psi and above, trans-  
mission factor are retained to  
prevent accidental damage to  
the connectors due to rough  
usage. For greater accuracy,  
a standard bridge resistance  
at 350 ohms is used with gold  
terminals and fiber-reinforced  
ALINCO unique electrical lead  
structure and mechanical lay-  
out minimize the effects of  
external loads. Ranges to  
3,000,000 lbs are available.  
The unique use of a single  
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surements where previously  
several parallel cells were  
necessary.

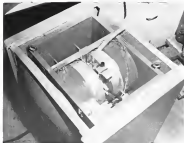
For additional information  
on the Model 344 Load Cells  
or for the answer to a specific  
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Riverside, California  
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## Detector Analyzes Solid Propellants

Nuclear magnetic resonance is being studied by Schlumberger, Inc.'s Ridgefield (Conn.) Instrument Group as a means for non-destructive analysis of the quality of solid propellants. Nuclear magnetic resonance detects about a 10% variance of self-potential for moisture variations of U.S. Army's Longhorn (Delaware) Missile. Marshall, Tex. (AW Oct. 12, p. 64). Unit is designed to continuously analyze composition of solid propellant produced in continuous process and would electronically control mixing of additives and fuel. The Longhorn facility is being tested under contract by The United States Corp. Schlumberger's Ridgefield Instrument Group also is investigating methods for non-destructive detection of aging in solid propellants. Proprietary analysis features of a nuclear magnetic resonance detector probe uses an aperture made in a solid propellant grain, as electron coating would detect leaks throughout the solid propellant grain (below).



LOCATION OF NMR HEADS  
IN FUEL SECTION OF A MISSILE

## WHO'S WHERE

(Continued from page 21)

### Changes

N. N. Rose, manufacturing manager  
Petersen Missile Systems Group, Lockheed  
Missile and Space Division, Sunnyvale,  
Calif.

Robert G. Wilson, manager of the local  
unit leading study program North American  
Vehicle's Missile Division, Downey, Calif.  
Robert E. Shultz, general manager of the  
Western Operations, Santa Ana, Calif., of  
CITL Division of Southfield Packard Corp.

George J. Gubowski, manager standard  
products Form of Inc., Ashland, Mass.  
Donald F. White, chief engineer, Radio-  
tron Electronics Co., Culver City, Calif.

Dr. Tai Nien Tang, associate director of  
research, Coda Technology Division of  
Control Data Corp., Minneapolis, Minn.  
Lawrence H. Winkler, manager of marketing  
services, ACP Industries, Inc., New  
York, N. Y.

Thomas L. Lohr, senior systems  
engineer in charge of Avionics Corp.'s new  
Electronic Air, Dallas.  
John H. Vukobrat, general purchasing  
agent, Solid Rocket Plant, Avco General  
Corp., Van Nuys, Calif.

Robert H. Lank, general manager, Data  
Lia Electronics Division of Japan Instru-  
ment Inc., Santa Monica, Calif.  
Gert L. Hansen, assistant chief engineer for  
design, General Instruments Division of  
General Dynamics Corp., San Diego,  
Calif.

Frank A. Fisher, assistant director for  
Naval Weapons Department of Defense,  
Washington, D. C.  
Ruehl J. Kelly, general manager, Avon-  
con Machine & Foundry Co.'s Buffalo, N. Y.

Harold T. Adewunmi, director of manu-  
facturing, Rockwell Co., Van Nuys, Calif.  
Dr. Joseph E. Toland, associate direc-  
tor of research, Rockwell Division, Philco  
Corp., Philadelphia, Pa.

Dr. W. Wei Chao, director of research  
and development, Velsco, Inc., division of  
Sperry Rand Corp., Detroit, Mich.  
Robert J. Reisman, manager Systems Di-  
vision, Rockwell Instruments, Inc., An-  
hove, Calif.

Barbara D. Blahut, consultant and man-  
ager of a newly established Design and  
Standard Engineering Group, Gen-  
eral Electric Co.'s Missile and Space Vehicle De-  
partment, Philadelphia, Pa.

Carl L. Cahill, general sales manager, An-  
con Radio Corp., Bala Cynwyd, Pa.  
M. J. Gendron, manufacturing engineer,  
Rockwell Avionics Corp., Van Nuys,  
Calif. Also the following are associated with  
project engineers: D. F. Bolognini for heavy  
iron analysis, R. F. Adair for light iron  
analysis.

Richard J. Hisselman, manager of market-  
ing, Rockwell Electronics Division,  
Rockwell Instruments Inc., Dallas, Tex.  
Nicholas A. Peluso, assistant chief engi-  
neer, Velsco, Inc., Van Nuys, Calif.  
John W. Connors, chief engineer, Rock-  
well & Development Division of Rock-  
well & Velsco, Inc., San Carlos, Calif.  
Dr. Vimal A. Vaidya, chief engineer,  
Rockwell Avionics Co., Santa Fe, N.M.

## Engine Pressure Ratio System Is ENVIRONMENTALLY SAFE



A/R Transducer

Highest reliability and accuracy of  
the Astronautics Engine Pressure Ra-  
tio System are assured because of  
three distinct advantages: 1) Only the transducers are mounted  
on the engine, subject to high shock  
and vibration. All wiring is done  
within the indicator on the instru-  
ment panel. Transmission is air-  
sealed.

2) No leakage or potential  
leakage. 3) The Pressure Transducers  
are all advanced design featuring  
anodized, fast dielectric and  
completely sealed induction pack-  
off rails. Accuracy of system is 1%  
of reading in the critical ratio  
range.

See it at Western-Space 82BA  
For technical data write:



671 W. Harvard St., Simsbury, Conn.

Branch 331 56 Ave., N. Y. 10



## DUAL CHANNEL BUFFER AMPLIFIER

This small, light-weight unit, a completely transistorized dual channel buffer  
amplifier, is designed to drive transducers via 11 9850 winding compensated  
synchro-resolvers. The amplifier receiver combination has stable gain character-  
istics and negligible phase shift through an ambient temperature range of -50°C  
to +85°C. This unit meets the environmental requirements of MIL-E-8839.

KRAFTPORT DIVISION  
John F. Kelly, Area Director



GENERAL PRECISION, INC.  
One Division 4th Avenue, New York



Convair design, utilizing direct cycle nuclear engines, has horizontal stabilizer-elevators mounted forward on nose section.

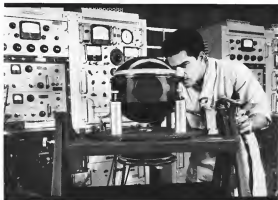
## Convair Designs Swept Wing Nuclear-Powered Planes



Two sweeping configurations, each having nuclear powerplants in the tail section, are among design studies under way at the F-1. With this, plant of Convair Division of General Dynamics. Plans studied for USAF (above) would be powered by three General Electric direct cycle nuclear engines installed in the fuselage, conventional turbojets using kerosene fuel are suspended from the wings in pods to augment thrust on takeoff and at high speeds. Convair believed will be subsonic and is intended primarily to test

engines, rockets, gun/missiles, altitudes and ground landing. Below is the Convair design for a nuclear-powered aircraft using Pratt & Whitney indirect cycle engines. This system has one reactor to supply heat to four turbojet engines by pumping hot liquid metal into the heat exchangers that takes the place of the conventional chamber. Direct cycle nuclear turbojets each have a reactor integrated with the heat exchanger to heat air passing through the engine.

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Today Hamilton Standard can supply the widest range of aircraft and missile ground support equipment—from tiny precision components and safety devices to complete architectural structures and weapon sub-systems. This capacity grows from Hamilton Standard's 40 years' experience in systems-engineering its own laboratories and broadening product line.

**IN SYSTEMS-ENGINEERING** its facilities and products, Hamilton Standard has carried out new concepts in precision gaging, electrical and electronic control, airborne vehicles, and other safety devices that are essential to many of today's sophisticated GSE systems. These programs have also produced an unusual knowledge of structures, materials development, and such critical technologies as:

**Electronics**—Hamilton Standard's experience in producing controls for its products and laboratories is readily applicable to such GSE as check-out tests, simulations, computers, and electrical and electronic test equipment.

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**Cryogenics and Fuel Handling**—Hamilton Standard is constantly working with low-temperature gases and fuels. This experience, plus extensive work with free air conditioning systems and fuel controls for liquid oxygen and liquid hydrogen, is a natural foundation for solving complex fuel handling or storage problems.

**UNMATCHED RESEARCH AND DEVELOPMENT FACILITIES.** As a division of United Aircraft Corporation, Hamilton Standard shares in one of the largest privately owned research installations in the aerospace industry.

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### SOME OF THE MANY FIELDS OF GROWTH AT HAMILTON STANDARD



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**ENGINE CONTROLS** for over 30,000 aircraft gas turbines have been produced by Hamilton Standard. The company's latest control work includes advanced rocket engines.



**STARTERS**—Over 15,000 a year of fuel air starters in service on wings of the nation's fleet line aircraft. The new B-71 system, shown, gives the weight and stability.



Side-by-side seating on the Navy-Corona is 22 1/2 inches long, 17 1/2 inches deep (130" May 8, p. 94) can be seen in this light view.

## Grumman Tests Twin Jet A2F-1 Intruder for Navy



Tailgates for two Full & Whiskey JEEP tailgates are adjustable (left) and can be lowered 90 deg. for VTTM, effect on takeoffs and landings. Each engine delivers 3,130 lb. thrust, maximum gross weight is 14,000 lb. Landing gear locks in two modes.

Swings in time spent on route can disperse passengers for the higher cost of the adult, compared with less time transport. For example it takes 60 minutes to reach Gonesse against 45 to reach St. Martin. In time, around 20 min to be placed

### Flying Time

BART also is instructor at the pilot training school which presently has 21 students including two 17-year-old girls. Courses in gliding are scheduled to be added to the school's program later on.

Exposure: Prolonged

Catering largely to tourists, the firm began operations last month upon the opening of Montour's new Remus Airport, making its first flight to the glacier on the top of the Matterhorn in the Swiss Alps.

On request, passengers arriving at one of the main cities or airports in Southernland are met and flown to their destinations. Under present plans, two full-time and two part-time pilots will operate increased flights on a regular

Thing true from Zurich to Montreux is 47 min., compared with 14 3/4 hr. and The Geneva-Montreux loop takes 15 min., at least 14 hr. by train and a flight to Nyon on the French Riviera from Geneva or Reims only. That is compared with 8.0 hr. by rail.

Argem, says the firm expects to conclude negotiations within the next future for the purchase of a *Riva Newton* four-seat aircraft from its past owner in Geneva. It will then be fitted with a 280 hp Lycoming engine and a Lear subprop. With a cruising speed of 140 mph, the aircraft will go into service between Rome-Blink, Zurich, Geneva, Milan and Nice.

Best trained in modern Alpine rescue pilot Yrjö Wänel of St. Moritz is the glacier landing technician, who conducts mountain rescue missions. To aid pilots engaged in this work, the Collins radio-equipped control tower now being built at Rostov will be connected to a radio tower high up in the Swiss Alps above Mont Blanc.

M. Markle-Villard, a Montevideo businessman, first conceived the idea of establishing a Montevideo charter yacht to serve the increasing number of

**Theoretical Concept  
is Turned into Hardware**

## Honeywell Develops a Practical



Mr. Robert Marx, Chief Engineer of Honeywell's Marine System Group, is reflected in the highly polished beryllium spherical rotor of Honeywell's new Electrically Suspended Gyro. The Marine System Group is a special Honeywell "task force" assigned to guide the ESG program through its rapid development.

## Electrically Suspended Gyro!

**Advanced new gyro concept using friction-free spherical rotor will bring greater accuracies to marine and airborne inertial systems, and northfinder systems.**

Honeywell's leadership in the field of inertial systems and sensors is further demonstrated with advances on its Electrically Suspended Gyro. Here the company has taken a theoretically superior gyro concept, conceived by Dr. Arnold Nordmark of the Univ. of Illinois, and turned it into practical development hardware. This new ESG concept is being developed under funding from the Navy Special Projects Office and Wright Air Development Division. Recognizing the unique capabilities of this new device, Honeywell has assigned a special task force group to continue to press the development of the gyro and the inertial system designed to take fullest advantage of the gyro's capabilities. In the near future, the Honeywell inertial system incorporating the ESG will be put into its test phase.

This new gyro has only one moving part, a spherical rotor, electrically suspended in a self-contained, hard vacuum to completely isolate the sensing element. The spherical rotor is made of beryllium, machined and polished to tolerances of a few millionths of an inch! The gyro is brought up to speed by electronic means, then coasts throughout long periods of operation. Reference information is picked off optically.

Honeywell, because of its experience in gyro components and systems, has already solved many problems related to this new gyro concept.

### **1. Precision Machining of Precision Metals:**

In order to take advantage of beryllium's high inertial stability, Honeywell has developed manufacturing techniques that overcome beryllium's brittleness and anisotropy problems.

### **2. Precision Ceramics:**

Honeywell has perfected the techniques for firing and machining the precision ceramic envelope, and for overcoming the difficulties in fabricating the ceramic to metal seals.

### **3. System Integration:**

Honeywell, with its advanced system experience, has created a new inertial system to take fullest advantage of the capabilities of this new Electrically Suspended Gyro.

For more information on Honeywell's new products, write to Minneapolis-Honeywell, Dept. AW-B-111, Minneapolis 8, Minn.



Precision ceramic envelope (rotor) is fired in a furnace at a temperature of 1800° C. Diamond grinding and diamond wheeling are utilized in finishing the envelope.



Beryllium rotor, after being machined, ground and polished, is checked for sphericity to tolerances of a few millionths of an inch.

## Honeywell



**Military Products Group**

High abrasion-resistance, good thermal insulation, high strength-to-weight ratio—all resulting from the unique R/M blend of phenolic resin and extra-long spraying-grade asbestos fibers—make choice of R/M Pyrodes evident for this and many other high-temperature applications.

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units in this popular resort area. It has taken less than 10 years to achieve her objective.

In 1957 he received some \$700,000.

The capital of the new company amounting to \$108,000, was received from local apartment buildings and a 2,000-ft runway. The success of the plan already has enabled the company to increase its capital to \$162,000. This sum will be used to extend the runway to about twice the size of its present length.

Recognizing the increasing popularity of the jet transports using the major airports in Switzerland, Baer told Avia, now Wifa, that the planned cruise extension is aimed at enabling larger jet-air-cargo aircraft such as the Douglas DC-3, Douglas DC-4 and the Convair 440 Metropolitan to land at Rorschach.



• **FF Goodies** now manufactures bellows and bellows assemblies to customer requirements. Customers should like the Greek logo. Omega (Ω) equals stress, result in extended on-site life. The design also improves accuracy, provides a more linear differential output. Write for new brochure, *Standard Bellows and Bellows Assemblies*®.

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aviation products

Don't miss it. *Don't miss it.*

**Scheduled increase in Pacific** Automotive Corp. Engine Division's volume is expected from the next year as a result of five contracts awarded to the unit with Volvo, Ford, Isuzu, Nissan, Toyota and Volkswagen. The 1989 schedule for new customers includes 100,000 units for Isuzu, 100,000 for Nissan, 100,000 for Toyota, 100,000 for Volkswagen and 100,000 for Volvo. The 1989 schedule for Volvo is in agreement with Continental AG. Volvo will increase. Ford & Whitehead engines for Continental AG. Volvo will increase monthly. Ford & Whitehead engines will be scheduled monthly for World Trucks. PAC will do Ford/Isuzu. Andrus Ford & Whitehead R-2500-C-166, their R-2500s will be scheduled per month for Suzuki Export Corp. and Transamerica. PAC is a supplier to their R-2500 1800 Honda engines.



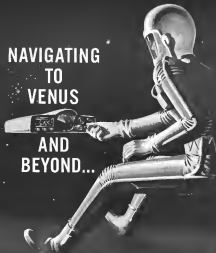
Light prototype YTF 31 F3 includes region demonstrate increased efficiency in 400G test flight

Having 11 SDI assets doesn't show above red light

to compare with prototype barbed Post & Winstanley, 21P-18P1 engine with the following specifications: shaft thrust—16,000 lb., shafts (shaft—16,000 lb. axial thrust—12,000 lb.). 75% of nominal—9,375 lb., shafting bar consumption (75% of nominal)—38, 444—150 lb. (consumed with the 2P of 21P18P1). Below the 21P18P1 thrust on low load tests in aviation effects on the crew and amount of light it radiates under 1600 H. Daily simulated crew members are performed by Strategic Air Command in test facilities of penetrating, crew defense by King under this radiations. Areas limited range from beyond the 200 to 100000 miles wide.



# NAVIGATING TO VENUS AND BEYOND...



## A CHALLENGE TO EXCITE ANY ELECTRONICS ENGINEER WORTH HIS SALT... THE KIND RYAN NEEDS RIGHT NOW

We do not know where Venus is, within 50,000 miles or more. What is needed is a guidance system capable of injecting space vehicles into interplanetary orbits with the accuracy required for advanced space missions.

We are confident that the C-W doppler system, of which Ryan is the world leader, will meet this challenge of space navigation. This is one mission Ryan is the largest electronics firm in San Diego — and the fastest growing! If you are an electronics engineer ambitious to help advance the art, as well as your own career, through vital "frontier work" — we want you right now at Ryan Electronics.

Ryan Electronics employs over 2000 people and has over one-third of the company's \$345-million backlog of business. Under the leadership of some of America's most prominent scientists and engineers, Ryan is probing beyond the known... seeking solutions to vital problems of space navigation.

Expanding facilities of Ryan Electronics at San Diego and Torrance in Southern California are among the most modern in the West. You enjoy living that's moved everywhere, plan facilities for advanced study. Send your resume or write for brochure today: Ryan Electronics, Dept. 1, 5650 Kearny Mesa Road, San Diego 11, Calif.



### First Iris Sounding Rocket Fired

Atlantic Research Corp.'s Iris sounding rocket, developed for National Aeronautics and Space Administration, made the first of three qualification flights from NASA's W-3000 Blvd., Virginia Tech. Feb. 12, carrying a 30-lb. instrumented payload to 140 mi. altitude. Iris is 10 ft. long, 12 in. in diameter, has a 4-in. fin span and weighs 1216 lb. without payload. Thrust is 3300 lb. and burning time 62 sec. Exhaust velocity is about 6774 ft/sec. When burning solid propellant, Iris is used to measure, give higher accelerations at greater altitudes where drag is lower. Iris uses a 40-in. semi-chamber burner with 16,000 lb. thrust and 8 sec. burning time. It will take loads of 100 lb. to short 200 in. Each development problem of chemical facilities comes and needs component development has been overcome, and NASA called Iris "highly successful." Iris is the largest of a family of three Atlantic Research Corp.-developed sounding rockets. Iris, the smallest of the two, carries a 12 lb. payload to 40 mi. altitudes, and Arion is capable of pushing 40 lb. payload to 60 mi. altitudes. (A photo below, the right is the largest) in the seven rocket cluster burner system.



## OPENINGS IN Aerodynamics Analysis & Development

**SENIOR DEVELOPMENT ENGINEERS** Three openings exist for senior level experienced aerodynamic engineers with the following qualifications:

BS or MS in Aero Engineering, Engineering Mechanics, or Physics, minimum 6 years in missile and/or aircraft dynamics. For analytical and design work in rigid and flexible body-motions.

BSAC or MSAC with 6 years experience in overall and/or sub-scale structural analysis and design. Good knowledge of structural stresses, load transfer, load path, stress analysis, strong in mathematics.

BS or MS Aero Engineering with 6 years experience in aerodynamics and related test transfer data. Will work in hypersonic, supersonic, transonic, atmospheric environments. Must be strong in mathematics.

Also: Openings for similar capabilities in the one-to-three year experience range.

**SYSTEMS ANALYSIS** Weapons Systems analysts with BS or MS in mathematics or physics, or MSCE, to work on weapons systems and weapons technology, including, simulation studies, feasibility studies, and weapon systems.

All above openings are in Menlo Park, CA. For complete information, write Allen J. Hoffman, Professional Recruiter, Dept. E, Ordinance Division, Honeywell, 400 Second Street North, Hopkins, Minn.

## Honeywell

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To explore professional opportunities in other Honeywell operations, visit us now, and make application to our Director of E. Hoffman, Honeywell, Minneapolis 1, Minn.



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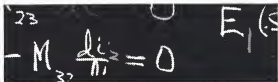
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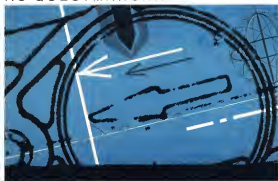
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General Motors pledges

## AC QUESTMANSHIP



**AC Seeks and Solves the Significant**—AC Design and Development is moving far ahead in new technology—the result of GW's commitment to make ever larger contributions to the defense establishment. AC plans to resolve problems even more advanced than AChiever inertial guidance for Titan. / This is AC QUESTMANSHIP. It's a scientific quest for the development of significant new components and systems . . . to advance AC's many projects in guidance, navigation, control and detection. / Dr. James H. Bell, AC's Director of Navigation and Guidance, sees this as a "creative challenge". His group takes new concepts and designs them into producible hardware having performance, reliability and long life. He strongly supports the fact that an AC future offers scientists and engineers "a great opportunity to progress with a successful and aggressive organization" / If you have a B.S., M.S., or Ph.D. in the electronics, scientific, electrical or mechanical fields, plus related experience, you may qualify for our specially selected staff. If you are a "Seeker and Solver", write the Director of Scientific and Professional Employment, Mr. Robert Allen, Oak Creek Plant, 7929 So. Howell Ave., Milwaukee, Wisconsin

**GUIDANCE/NAVIGATION/CONTROL/DETECTION/AC SPARK PLUS** The Electronics Division of General Motors

space station which was set at the base for a large number of school children. It was actually significant that as one of the ground was often killed or injured. A few days later the company attempted to recover the pilot from the wreckage, several years later when the aircraft had been flown.

### Wreckage Examined

Inspection at the scene of the accident confirmed that the aircraft had died as the ground as a very serious strike. With the exception of the outer section of the wing, the aircraft was almost entirely intact.

The flap and landing gear were retained. There was no evidence that the aircraft had been on fire in the air.

The standard fuel tank was in the left position. There was no evidence that the standard engine was running when the aircraft was under power.

Damage sustained by the pilot's push control mechanism of the standard propeller indicated that the control lever was in the feathering position at the time of impact. Both propellers were in the constant speed pitch range but the standard was at a pitch angle nearer to the feathering position. There was no evidence of any pitch control defect.

### Observation

It is probable that during the initial air action of the standard propeller the pilot control was in the (a) position. The engine did not develop power and the aircraft lost speed due to drag from the windmilling propeller. Under the prevailing conditions the performance of the aircraft with a propeller windmilling and such serious power loss, the effect on the aircraft would have been a very small one of climb. The fact that the standard propeller was not feathered and that the pilot push control lever was in the feathering position indicates that the pilot had in fact feathering action at the last moment.

### Conclusions

- (1) The aircraft had a valid Certificate of Airworthiness.
- (2) The aircraft was correctly loaded.
- (3) There was no pre-impact failure of the aircraft or its engine or propeller.
- (4) The pilot's action was valid for the flight.
- (5) The pilot was experienced in the aircraft and was not subjected to any undue stress during the flight.
- (6) The standard engine fuel tank was fitted in the correct position.
- (7) The drag of the windmilling propeller resulted in loss of speed.
- (8) The flight was carried out in accordance with the regulatory minimum safe altitude.

### Opinion


The accident was the result of loss of control in an experienced pilot during an attempt to return to airport following a very serious fight at a very low altitude.

W. F. Deacon  
Deputy Chief Inspector of Accidents


## MPB announces . . . 3 new R's of instrument bearings

Latest additions to the large, fast-growing MPB family are ultra-precision R2, R3, and R4 instrument bearings.


To their many familiar applications such as computers, servos, synchros, gyros and generators, MPB's R Series bearings bring quieter performance, longer life and reduced friction—the results of MPB's advanced production techniques, thorough quality control and constant emphasis on precise, accurate bearing geometry.



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Basic material for the R Series is 440C stainless steel. A new type ribbon retainer, for low uniform torque, is available, as are duplex mountings and preloaded pairs. ABEC Class 7 tolerances maintained in all types and sizes. Standard dimensions are:

	Bore	O.D.	Width
R2	.125"	.675"	.150"
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Over 100,000 openings in U.S. and foreign firms are currently seeking experienced engineers for temporary assignments within their various divisions.

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## Microwave Engineers

Leakert Electric Co., a leading manufacturer of high performance carrier telephones, microwave and data transmission equipment has immediate openings for several microwave engineers in the development of microwave radio systems for mobile channel telephone service. Experience in wave amplifiers and broad band IF circuits, microwave test and design techniques and an understanding of semi-conductor applications in the microwave region is desirable. 5 to 10 years experience with a BS degree or higher required. Top salary based on experience, including a stock purchase plan. Modern engineering labs located on the beautiful San Francisco peninsula.

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Structural and Control Systems

BS to MS in Mechanics or Mechanical Engineering and ability to write good reports and present results. Some positions are non-traditional and require some field activities and fieldwork.

Excellent company benefits including tuition free graduate study and a liberal retirement plan. Please send resume to:

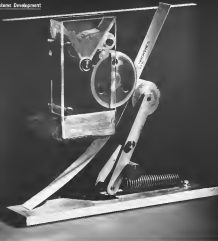
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**ARMOUR RESEARCH FOUNDATION**  
of Illinois Institute of Technology

70 West 35th Street

Chicago 18, Illinois

## Opportunities in Systems Development



## Bringing to life the principles of magnetic printing

The little head-crumb model makes possible one of the principles of magnetic printing—principles that have been known in theory for more than a hundred years.

The model represents a big jump from theory to practice. It was developed and built by a group of IBM engineers and scientists brought together for the sole purpose of proving or disproving the feasibility of the magnetic printing process.

These IBM researchers discovered a way to "write" characters on a rotating metal-ceramic platen drum by coating magnetic dots onto the drum with true magnetic ink. The latest magnetic image attracts and holds powdered characters. The ink is transferred to paper and permanently bonded by passage through a heat and pressure fix station.

The machine at left has a writing speed of 185 inches per second—equivalent to 1,000 words a minute. It can be operated for six-

teenth periods at 180 inches per second. A full parallel printer based on these principles is capable of producing many times the output of the fastest IBM impact-type printer.

### Engineering Achievement

The magnetic printer project is typical of the many opportunities for achievement awaiting engineers and scientists in advanced research development at IBM. Perhaps you might be more interested in what IBM people are doing in such areas as: semiconductor, thin-film devices. If you have an engineering degree and would like to learn more about these opportunities, write, outlining briefly your experience and field of interest, to:

**Manager of Technical Employment**  
IBM Corporation, Dept. 32413  
800 Madison Avenue  
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## Chemical and Lubrication Engineers Outstanding Career Openings at Boeing

Boeing's Transport Division has immediate openings for experienced men to work as members of the Structures Staff in research into aircraft applications of lubrication, surface preparation and inorganic finishes.

These positions are:

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